THE CHERRY AND ITS CULTURE

V. R. GARDNER

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The Cherry and Its Culture

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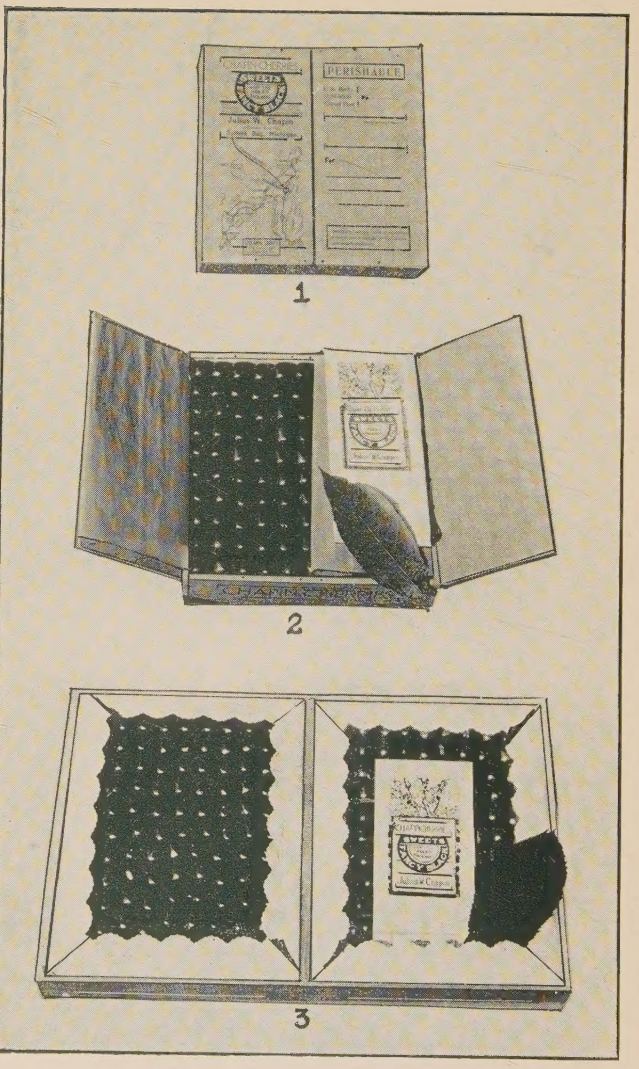

THE HARVEST—SOME FANCY CHERRY PACKS

THE CHERRY
AND ITS CULTURE

BY

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Michigan Agricultural Experiment Station

ILLUSTRATED

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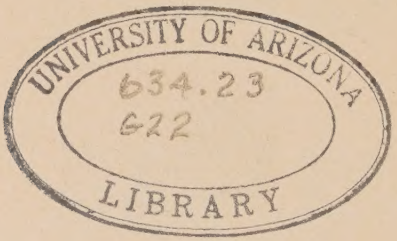

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PREFACE

THE CHERRY has never been a contender with the apple, the grape, the banana and the orange for first rank among cultivated fruits. Probably it never will. It has, however, come to occupy a prominent place among those of second importance. There is in the fruit itself a certain sprightliness of flavor that one associates with the orchard and garden products of late spring and early summer that will continue to make it popular. The demand will grow rather than decrease.

Much has been written about the cherry and its culture but most of the articles have appeared in magazines, or as chapters in books devoted to fruit growing in general. Neither these articles nor the elaborate monographs devoted to the cherry are readily available for the great numbers of amateurs and commercial producers who wish to grow this fruit. This book has been written with the object in view of bringing together a fund of information on the cherry and its culture that will be equally useful to the amateur who has only a few trees, and to the commercial producer who may have several hundred acres.

The author is indebted to the Horticultural Section of the Michigan Agricultural Experiment Station for all of the illustrations except Number I, which is taken from "Geography of the World's Agriculture," by Finch and Baker.

V. R. GARDNER

East Lansing, Michigan

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The Cherry and Its Culture

I

HOW THE CHERRY HAS BEEN DEVELOPED

No one knows when or where the cherry was first introduced into cultivation. Probably its progress from a wild to a semi-wild and finally a cultivated state corresponded with that of the apple, pear and plum, for all were native to the same general region and all were well known, much prized and grown in considerable variety before the dawn of the Christian era. Furthermore, as with these other fruits, there is little to say regarding its history or development between ancient and modern times. Along with them, it emerged in the 16th century, in somewhat greater variety than it was known in ancient times, still popular, but grown by amateurs for home use or very limited local sale rather than for commercial purposes. The next three centuries, however, witnessed the introduction of many new varieties, not so different from those of an earlier period, perhaps, as the apples and pears of today are different from their ancestors of 15 and 20 centuries ago, but nevertheless representing considerable improvement.

Practically all the cultivated cherries of today have been derived from two species, both of which are native to central and southern Europe and southwestern Asia. These are the sour cherry *(Prunus cerasus)* from which

both the light and dark colored sour varieties have been developed and the sweet cherry *(Prunus avium)* from which the sweet varieties and the so-called Mazzard types have sprung. The Duke cherries, assigned by some to a third species, are with equal propriety considered by others as hybrids between the sweet and sour groups. Other species of cherries are found native to the regions where Prunus cerasus and Prunus avium grow wild and still others are found native to other parts of the world, but they have not yielded varieties that are grown extensively for their fruit. The so-called Mahaleb cherry (Prunus mahaleb), which is native to central and southern Europe, is used as a stock upon which to bud or graft many of the cultivated varieties. Several of the Japanese species are grown extensively for ornamental purposes and the so-called Bird cherry of the United States is valued for its wood. A Chinese species (Prunus tomentosa) is grown to some extent in both China and Japan as an ornamental and for its fruit. Recently this species has attracted some attention in the northern part of the Mississippi valley and in the Canadian prairie provinces, where winters are too severe for the survival of the common sweet and sour varieties.

A comparatively large percentage of the important cherry varieties of today are of European origin, coming from England, France, Holland or Germany. Many of them have been in cultivation for a comparatively long time and their origin is obscure, the assumption being that they appeared as chance seedlings; then, as their superiority was recognized, they were propagated by means of budding or grafting. There is evidence that some of these more important so-called varieties are not varieties in the strict sense of the term, but could be

more accurately referred to as types. By this is meant that they are in reality collections or groups that are *almost* alike in their characteristics, so much alike that it is impracticable and almost impossible to distinguish between their various members. This has come about through the fact that a century or more ago it was customary to propagate the cherry by means of seed, both because seedling propagation is easy and because the cherry is more inclined to reproduce comparatively true to type from seed than most other fruits. The result was that Morello-like or Kentish-like or Napoleon-like seedling trees would be called Morello or Kentish or Napoleon, as the case might be. The significance of this fact will appear later in the discussion of pollination and fruit setting.

Many varieties, particularly of the sweet cherry group, have originated in America. Some of these, such as Bing and Lambert, have come to occupy prominent places in the commercial lists.

New varieties are being introduced from time to time and occasionally one of these newer kinds is able to displace an older one or perhaps to make a place for itself without displacing another. The fact remains, however, that the cherry variety lists have undergone less change within the last generation or within the last century than the variety lists of most other fruits. This does not mean that there is no further room for improvement but rather that there are fewer changes in the trade's specifications as to what constitutes an ideal cherry and that a number of present day varieties measure up fairly close to those specifications. In other words varietal standardization has proceeded further in the case of the cherry than it has with most other fruits.

For this reason the cherry grower can plant an orchard with greater confidence that his variety list will meet satisfactorily both present and future market demands than is true in the case of almost any other fruit.

II

THE DEVELOPMENT OF THE CHERRY INDUSTRY

THOUGH the cherry has always constituted a more or less important part of every home orchard in the central and northern part of the United States and in eastern Canada and parts of British Columbia, it was not until comparatively recently that an extensive commercial industry has been developed. This is because the ripening season is comparatively short and the fruit itself is not well suited to long storage or distant shipment. With the development of cold storage and the refrigerator car system and, more important still, the commercial canning industry, cherries of one kind or another are available to the entire population every day in the year, instead of only to those living within a short distance from where they are raised and for a four to six week period. This combined extension of markets and marketing season has greatly increased the demand, especially for those types suited to commercial canning and long distance fresh shipment, and has made possible the development of one of the important tree fruit industries.

Some measure of the rise of the cherry industry and of the vicissitudes through which it has passed is afforded by the figures presented in Table 1, giving the number of bearing trees in several of the more important cherry raising states and in the entire United States at 10 year intervals, beginning with 1890. It will be noticed, in the

first place, that none of the more southern states is included in the list of those that are comparatively heavy cherry producers. This is not because cherries are not prized by southern people nor is it because they have not been tried in southern districts, but because their culture is more difficult than it is further north. The trees themselves are more subject to the leaf spot disease and the fruit is more susceptible to brown rot and curculio attack. Extremely thorough spraying is necessary if satisfactory crops are to be produced. The decrease in tree number during the past one or two decades in such states as Virginia, West Virginia, Missouri, Kansas and Nebraska is probably to be attributed, at least in part, to the disease factor.

The more northern states alone, California excepted, have shown a steady increase in cherry production. This has been due in part to the fact that apparently the cherry is better suited to their cooler climate and in part to the fact that commercial fruit canneries located in those regions furnish an outlet for the crop. Historical evidence, however, indicates that the canneries have been built to take care of the crop rather than it being a case of trees being planted to supply the canneries, though after a cannery has been established further planting in its vicinity is likely to follow. In California there has been a steady increase in acreage and, on the whole, a corresponding increase in tonnage and value of crop. No figures are available showing the proportion of the California crop that is used for processing and the proportion that is shipped fresh, though some indication is given by data presented in Table 2.

Further evidence on the influence of climate on the development of the commercial cherry industry is furn-

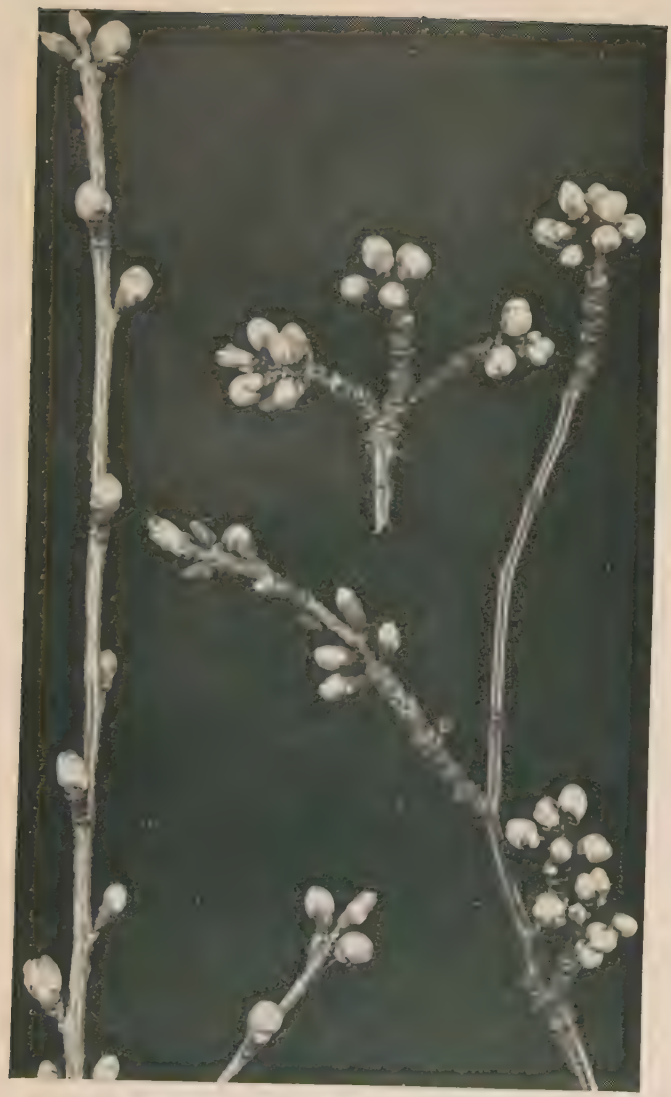

FIG. II.—AT THIS STAGE THE FLOWER BUDS OF THE SOUR CHERRY ARE VERY SUSCEPTIBLE TO INJURY FROM COLD

Eighty per cent of the blossom buds on Montmorency trees in this condition were killed at East Lansing, Michigan, on April 18, 1929, when a sheltered thermometer registered a minimum of 28° F.

FIG. III.

FIG. IV.

Fig. III.—A Montmorency cherry tree near the close of its first season in the orchard that has made a vigorous and satisfactory growth.

Fig. IV.—A young English Morello tree almost completely defoliated by the leaf spot disease before the crop has matured. Cherries borne on trees infected in this way seldom mature properly. Furthermore, it renders the trees especially susceptible to winter-injury of the blackheart type.

TABLE 1. Number of cherry trees of bearing age in the entire United States and in several of the leading cherry producing states, by decades.

	1890	*1900*	*1910*	*1920*
United States	5,638,759	11,943,287	11,822,044	10,787,751
New York	.....	539,742	673,989	1,027,203
Pennsylvania	465,867	956,273	1,075,031	951,924
Ohio	368,311	697,270	1,144,271	805,838
Indiana	617,168	896,641	815,742	475,333
Illinois	288,836	727,973	843,283	536,458
Michigan	447,334	895,375	760,183	1,076,748
Wisconsin	.....	273,740	290,495	437,480
Iowa	199,067	791,327	908,764	391,226
Missouri	381,185	679,985	622,332	522,026
Nebraska	175,944	607,017	494,468	289,221
Kansas	1,087,890	1,109,673	661,267	395,436
Virginia	.....	269,690	352,783	236,199
West Virginia	.....	300,363	332,429	284,739
Colorado	.....	127,001	203,806	348,832
Washington	.....	210,516	241,038	329,187
Oregon	.....	237,155	223,456	395,073
California	236,945	686,891	522,304	657,470

ished by Figure 1, showing its localization in certain restricted regions. Thus, Wisconsin is credited by the 1920 census as having 437,480 cherry trees of bearing age, but over half of these were found in Door County. Three-fourths of the cherry trees of Oregon are found in the Willamette, Umpqua and Walla Walla valleys and about The Dalles. Commercial cherry production in the other states is only a little less definitely localized. This localization appears the more striking when compared with the condition found in many of the other fruit industries. Its implication is that the cherry is somewhat more exacting in its climatic requirements than most of the other deciduous fruits. This is particularly true of the sweet cherry, which is grown successfully within distinctly narrower limits than the sour varieties.

The statements that have just been made, however, should not be interpreted as implying that the cherry, even the sweet cherry, should not be much more generally planted for home use and for local market. Indeed there is abundant evidence that cherries can be grown with sufficient success to warrant at least their limited culture throughout two-thirds to three-fourths of the area of the United States. In some sections the trees may not be so long lived, so productive nor so regular in their bearing as in others and control of diseases may be somewhat more difficult, but at that they are proving profitable for local markets in places far removed from areas where large commercial orchards are advisable.

The Commercially Canned Product—A comparatively small percentage of the sour cherry crop is used in its raw or fresh state. Most of it is canned or preserved in some other way. Of course large quantities of the fresh cherries are sold through retail stores but

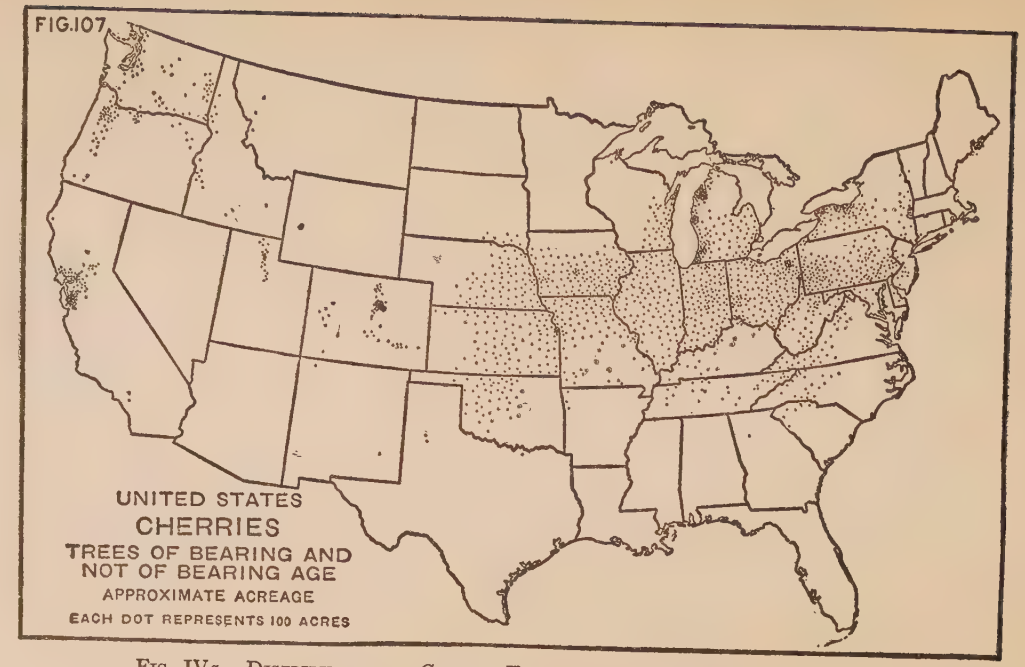

FIG. IV*a*.—DISTRIBUTION OF CHERRY TREES IN THE UNITED STATES IN 1919.
After Finch and Baker

they are principally for home canning and the restaurant and bakery demand is almost entirely for the canned product. Figures presented in Table 3 afford some idea of the rapid development of this phase of the industry. Comparatively few sour cherries are grown in the Pacific Coast states.

Sweet cherries are grown both for canning and for eating in the fresh state. Most of the light-colored sweet cherry varieties are used in the former, most of the black varieties in the latter way, though there is a limited demand for canned black sweet cherries. The principal sweet cherry industry is located in the Pacific Coast states, though considerable quantities of the black varieties are grown in Michigan and New York. Fresh black sweet cherries from California are on the market from May to July; most of the eastern sweet cherry crop ripens in July and August. Some measure of the popularity of the black sweet cherry for eating out of hand is afforded by the fact that the records show that in 1926 and 1927 18 per cent of the total sales from a representative group of farmer's roadside markets in Michigan consisted of sweet cherries.

Maraschino Cherries—During recent years there has been a gradually increasing demand for a special sweet cherry product known as "Maraschino." This is manufactured almost exclusively from cherries of the Royal Ann or Napoleon type. It is used in salads, by cake and pastry bakers, and by ice cream and confectionery manufacturers. Production for this trade is limited to the Pacific Coast, where upwards of 5,000,000 pounds are used in this way annually. The fact that imports of Maraschino cherries amount to about 15,000,000 pounds

TABLE 2. Estimated cherry acreage, production and shipments for California.

YEAR	*Estimated bearing acreage*	*Estimated total production tons*	*Value per ton*	*Estimated total value*	*Carlot shipments*
1914	8,200	.....	...	.....	...
1915	8,269	.....	...	.....	...
1916	8,240	.....	...	.....	...
1917	8,428	.....	...	.....	...
1918	8,616	.....	...	.....	...
1919	8,750	12,400	$150	$1,860,000	...
1920	8,884	17,500	200	3,500,000	641
1921	9,082	13,000	125	1,625,000	783
1922	9,829	14,000	180	2,520,000	751
1923	10,158	17,000	160	2,720,000	904
1924	10,439	13,500	140	1,890,000	839
1925	10,945	12,000	160	1,920,000	697
1926	11,350	20,000	180	3,600,000	...
1927	12,593	.....	...	.....	...

annually indicates that there is considerable opportunity for the domestic expansion of this industry.

Frozen Cherries—Still more recently a demand has developed for frozen pitted cherries of the Montmorency type. This demand is supplied by commercial canneries that are equipped with cold storage facilities. The cherries are pitted and packed in barrels, with or without sugar, and at once placed in storage at a temperature of 10° to 15° F., where they are held until called for by the trade. They are used by bakeries, restaurants and in the manufacture of ice cream and ices. Some idea of how this demand is increasing is afforded by the records of one canning organization which first put up 300 barrels of frozen Montmorency cherries in 1922; in 1924 it packed 600 barrels, in 1926 3,100 barrels and in 1928 11,500 barrels. The rather general utilization that is coming to be made of mechanical refrigeration by various types of retail stores, coupled with the fact that the canners are starting to pack the frozen product in smaller containers, promises to make possible still further growth of this particular phase of the industry, since this product makes very pleasant eating without cooking as well as being suited to various culinary uses.

TABLE 3. Statistics on the canned cherry output of the United States.

State	*Cases packed in 1910*	*Cases packed in 1919*	*Cases packed in 1927*	*Value of 1927 pack*
California	224,084	618,210	228,991	$1,426,911
Colorado	8,470	51,929	40,995	180,914
Maryland	10,092	6,757	6,131	27,315
Michigan	20,572	184,472	266,218	1,194,051
New York	90,445	30,636	471,537	2,023,423
Ohio	.....	10,676	.....	.....
Oregon	22,770	149,203	114,877	637,377
Utah	.....	33,079	56,483	232,287
Virginia	.....	1,812	.....	.....
Washington	.....	146,782	170,273	968,731
Other States	13,918	129,276	131,126	562,116
Total	390,351	1,362,832	1,486,631	7,253,125

III

LOCATIONS, SITES AND SOILS

IN TREE the sour cherry is fully as hardy to winter cold as the pear and only a little less hardy than the apple. It is not unusual for its top to survive a winter in places where the roots kill, provided fungi do not complicate the matter through making the wood more susceptible to winter injury. Because of this tenderness of root and also because of a similar tenderness of its fruit buds its northern limits fall a little short of those of several of the other fruits. In New York, Michigan and Wisconsin its northern range is considerably extended in restricted areas, due to the moderating effect of nearby bodies of water. No exact lower temperature limit can be given to which the sour cherry is resistant and beyond which it is killed, for much depends on the condition of the trees themselves as well as on the time during the winter when the low temperature is registered, early extreme cold usually being more damaging than the same temperature coming later in the season. It may be stated, however, that it is not safe to plant the sour cherry where winter temperatures often fall below -25° F., and -20° F. is sometimes accompanied by considerable killing, especially where the trees have been weakened by overbearing or by premature defoliation by the leaf spot fungus. On the whole the wood of the sweet cherry is but little hardier than that of the peach and its northern range extends only a little beyond where peaches are grown successfully.

The fruit buds of the sour cherry, however, are destroyed by temperatures distinctly less extreme than those easily withstood by the blossom buds of the apple. Moreover the fruit buds of the sweet cherry are even less resistant to cold, -15° F. being closer to the lower limit that is safe for them.

The temperature factor, however, that more frequently sets the boundaries for sweet cherry (and sometimes sour cherry) production than midwinter minima is the occurrence of late spring frosts. Cherries bloom comparatively early and their swelling buds are susceptible to frost injury long before the flowers open. Indeed, the cherry is more or less unique among the so-called hardy fruits in the marked susceptibility of its fruit buds to injury from cold in the pre-blossoming stage. This factor is of as great importance with the sweet cherry in many of the central and more southern districts as it is the northern states. Commercial plantings of the sweet cherry should be made where air drainage is the best or where proximity to large bodies of water tends to hold the trees dormant in the spring until danger of frost injury is comparatively small. The relative importance of these two temperature factors in sweet cherry production is well illustrated by the experience of growers in the Michigan fruit belt, a strip of varying width along the eastern shore of Lake Michigan. The main production is in the northern half of this area, rather than the southern half. This is because in the northern district the trees are later in their blossoming and therefore less subject to frost injury and in spite of the fact that winter temperatures are lower and winterkilling of fruit buds somewhat more frequent. —It should not be inferred from these statements, however, that the opening flowers of the sour cherry are not

subject to frost injury. Indeed there is a stage in their development (illustrated in Figure 2) when they are more susceptible to injury from cold than are the flower buds of the sweet cherry. A little later in their development they seem to acquire a slightly greater resistance to cold, so that a temperature of 28° F. while the cherry is in full bloom is not likely to prove as damaging as it would have been at an earlier stage.

As already stated, disease usually sets the southern limits of cherry culture. High summer temperatures, especially when coupled with humidity, are favorable to the development of both brown rot and the leaf spot or shot hole fungus. Careful, timely and frequent spraying will, however, control these diseases and make possible a profitable cherry culture well south of the Mason-Dixon line.

Site—After what has been said about the early blossoming traits of cherries, especially those of the sweet group, and the localization of the industry with reference to bodies of water, there should be little need of discussing sites. It is almost impossible, however, to over-emphasize the importance of site in determining the success or failure of the cherry orchard. Within practically every one of the commercial cherry raising districts are individual orchards that have seldom or never missed a crop because of frost damage. Near them, perhaps within a half mile, are other orchards that have had half their crops destroyed or reduced during the same period by freezing temperatures during or just before blossoming. Indeed there are orchards thus located that have never borne a full crop because of bud and blossom killing. In this connection the 1920-1928 record presented in Table 4 of two 20-acre blocks of Montmorency trees set in 1913

TABLE 4. The 1920-1928 production records of two 20-acre blocks of Montmorency cherry trees set in the spring of 1913

They were on soils of similar character, owned by the same man and given the same care. One was well located from the standpoint of frost injury. The other, 10 miles distant, was less favorably located.

YEAR	*Price received per pound*	*Orchard ½ mile from Lake Michigan, on good site*		*Orchard 10 miles inland on a frosty site*	
		Yield in pounds	*Gross receipts*	*Yield in pounds*	*Gross receipts*
1920	$0.08	63,575	$5,086.00	35,656	$2,852.48
1921	0.10	12,630	1,263,00	4,853	485.30
1922	0.06	123,000	7,380.00	44,525	2,671.50
1923	0.06	110,672	6,640.32	83,587	5,015.22
1924	0.05	118,301	5,915.05	90,913	4,540.65
1925	0.05	115,995	5,799.75	117,323	5,866.15
1926	0.06	72,424	4,345.44	22,319	1,339.14
1927	0.10	109,102	10,910.20	2,178	217.80
1928	0.07	97,555	6,828,85	143,390	10,037.30
Total		823,254	54,248.61	544,642	33,025.54
Average per acre per year ..		4,574	301.38	3,025	183.47

tells a vivid story. The two blocks are less than 10 miles apart, growing on the same type of soil. They were owned and developed by the same man and received as nearly as possible the same care. One occupied a nearly ideal site, a half mile from Lake Michigan. The other was 10 miles inland and so situated that air drainage was not very satisfactory. Only once during the 9-year period for which detailed records are available was there frost injury in the one orchard. That was in 1921 when freezing temperature accompanied by a high wind on April 9 followed a two to three day period of 72° F. during which the buds had swollen rapidly. In seven of the nine years frost took its toll in the other block. Without doubt the poorer of the two orchards has been "paying its way," though it has not yielded a very large profit. On the other hand the second orchard has been a very profitable enterprise. Viewed in one way the one piece of land is worth at least $1000 per acre more than the other *for cherry production,* because the difference in net return between the two areas has exceeded the equivalent of a good rate of interest on that amount. The owner was fortunate in that the land on which both of these orchards were planted represented a purchase price of only $60.00 per acre. He would have been more fortunate had he paid someone that amount to take the one piece off his hands and then paid twice that amount for additional land like that on which the other was planted. Between such extremes are all gradations, and the difference between them is one associated with and due to differences in elevation and consequent air drainage.

Sometimes very minor differences in elevation are associated with a considerable difference in temperature on a frosty night and often a difference of one or two

degrees in temperature at a critical period means the difference between no killing and extensive killing of buds and blossoms. The writer knows of one sour cherry orchard in northern Michigan where there is a difference of 20 feet in elevation between the highest and lowest points. Once during a five-year period (1924-1928) there was a general killing of opening flower buds throughout the orchard, due to a late April freeze. Full crops were borne the other four years by the trees on the higher land, but only during two of those years by the trees on the lower ground. As between the two sites, the one is good for about four, the other for two or perhaps three, full crops out of five. Expressed in another way, here is a difference of 25 to 50 per cent, a difference great enough to make the undertaking a very profitable or very much of a losing venture. When it is realized that in many instances the differences between different parts of the same orchard and between different, even adjoining, orchards that are occasioned by site are much greater than this one, some idea is gained of the importance of site in cherry production.

Of course in the home orchard or fruit garden, comparatively little attention can be given to site and it is of relatively less importance, for occasional crop failure entails no serious financial loss. The back yard gardener can, however, avoid giving his cherry trees the warmest spot around the house where their buds are likely to be forced out prematurely.

Humidity—Humidity has already been mentioned as a factor of importance in cherry culture. Brown rot, the scourge of many growers, develops and spreads very rapidly during hot humid weather. Thorough spraying is effective in holding it in check on sour cherries, but less

effective in case of the sweet and Duke groups. Another, more direct and even more important influence of high atmospheric humidity at harvest time is to cause the fruit to crack. The sweet and Duke varieties are much more subject to cracking than are those of the sour type. For this reason a comparatively dry climate is far more favorable for the culture of the sweet and Duke cherries than is one that is relatively humid. There are, however, marked differences between varieties in their susceptibility to cracking, though in some instances this is due more to their season of ripening, as related to periods of rainfall and varying atmospheric humidity, than to actual differences in character of flesh or skin. Thus, in Michigan, Lambert is far more susceptible to cracking than either Napoleon or Bing, while in the Willamette Valley of Oregon the reverse is the case. Sour cherries, on the other hand, which are much less susceptible to brown rot and which seldom crack, are less exacting in their requirements and may be grown successfully in both humid and dry climates. Varietal, as well as group, differences in this respect should be taken into consideration when selecting varieties for planting and those should be chosen that seem best adapted to the existing conditions.

Soil—Cherries are grown successfully on a great variety of soils. Indeed they may be found thriving in home orchards and about the home grounds in everything from the stiffest clay to almost pure sand. The sour cherry, at least, is probably more tolerant of adverse soil conditions than most other tree fruits. This is far from stating that commercial plantings are advisable on all soil types, but there are few home orchards or home grounds where it is impracticable to plant cherry trees because

of unsuitable soil. In general cherries of all kinds do better on the lighter sandy or gravelly loams than on soils of a heavier character. This is particularly true with the sweet varieties. Indeed many of the most successful sweet cherry orchards of the Pacific Northwest are located on soils that could almost be designated as sands. Such soils usually possess excellent drainage, a matter of first importance in cherry culture, thus permitting deep rooting and making possible the withstanding of long periods of dry weather. In the more northern cherry growing sections, however, it should be remembered that light soils freeze deeper than soils of a heavy character and cover crops should be planted or other measures should be employed to prevent deep and severe freezing and consequent root injury. Sour cherries, especially the English Morello and a few others with a distinctly dwarfish habit, will do relatively better on shallow soils than will most other tree fruits; but vigorous growth, long life and heavy production are impossible under such conditions.

Fertility of soil is perhaps of less importance in fruit production than is soil depth and physical character. It is nevertheless of great importance. It is not uncommon to see areas in mature cherry orchards where the trees are only a half or a third as large as those of the same age a short distance away, the difference being associated with a change in soil character and apparently due to that factor alone. Production costs per pound are greatly reduced and profits per pound and per acre are greatly increased where large yields are obtained. Continued heavy production is practically impossible in a soil low in fertility. Much can be done through the use of green manuring crops and fertilizer to improve the fer-

tility of many soils but such applications seldom entirely compensate for a lack of natural fertility.

The person who selects a suitable site for the orchard has taken the first of the four main steps that are necessary antecedents to success in cherry production. If he then still further limits his choice to a deep, fertile, well drained loam, he has taken a second step that will go far toward guaranteeing heavy yields, low production costs and a margin of profit instead of a deficit at the end of the season's operations. Things that come later in the establishment and the management of the orchard are of equal importance, but no matter how well they may be done or provided for, any considerable degree of success without these first two prerequisites is impossible. They may be considered as basic, fundamental.

IV

ESTABLISHING THE ORCHARD

As has already been stated, cherries are more inclined than most other fruits to reproduce true to type when propagated by means of seeds. Seedlings, however, show considerable variation—altogether too much to make it practicable to propagate in that way. Vegetative propagation is consequently employed almost universally. In practice this means propagation by means of budding. Individual growers can, of course, propagate their own trees, but few find it practicable to do so. Nursery-raised trees as a rule are more uniform and generally they will be found less expensive than those raised on the farm, if full account is taken of all labor that is expended on them.

Stocks—Two stocks, Mazzard and Mahaleb, are in common use in the propagation of the cherry. Mazzard is a name given to designate a wild or semi-wild type of the sweet cherry that bears small, black and more or less astringent, bitter fruits. Seeds for stock purposes are obtained from trees of this type growing in central and southern Europe, where it is native, or from trees of the same type that have escaped from cultivation in sections of the United States where the sweet cherry is grown. In place of Mazzards some nurserymen have used seedlings grown from seeds of the ordinary sweet cherry varieties obtained from canning factories. Such seedlings are likely to be less vigorous, less uniform, and

less satisfactory than true Mazzards, though any lot of them will include some Mazzard-like individuals.

Mahaleb is a name given to a species of cherry more closely related to the sour than the sweet types, native to southwestern Europe. Like the Mazzard, it is propagated by means of seeds, the supply coming from wild trees in southern Europe. If left to develop naturally it makes a thick, brushy-topped, spreading tree of small size.

The sweet, sour and Duke types of cherries are propagated on both of these stocks. Mazzard stock is used almost exclusively on the Pacific Coast in the propagation of the sweet cherry and to a considerable extent for the other types. It produces trees that are somewhat larger and more productive than those grown on Mahaleb roots, though apparently it is not so well suited to the heavier soils. In the eastern states Mahaleb stock is in much more common use, especially for the sour varieties. Probably Mazzard stocks are to be preferred for both sweet and sour varieties in those eastern sections where winter temperatures are not too extreme. Investigations conducted by the New York Agricultural Experiment Station have shown that trees of all three types grown on Mazzard stocks not only make larger, more vigorous and productive trees, but that they are longer lived and even as young trees show a lower mortality. There is clear evidence, however, that the Mahaleb root is hardier than the Mazzard and winter killing of roots is a factor of considerable importance in cherry culture in a number of the northern sections. Mahaleb stock is to be preferred under such conditions.

Sour cherry seedlings have sometimes been used as stocks but they are unsatisfactory because of their suckering habit. The native "pin" cherry or "bird" cherry

FIG. V.

FIG. VI.

FIG. V.—A street cherry tree trained to a central leader. The central axis is the dominant feature of the tree's framework. One of the lower branches, however, has outgrown the others and it would have been better had it been somewhat checked by cutting it back several years before the picture was taken.

FIG. VI.—A street cherry tree started as a leader-type tree. The laterals, however, were permitted to outgrow the leader, which was eventually girdled and killed. When the dead leader is broken or pruned out it will leave what is essentially an open center tree of the poorest type. Girdling of the leader could have been prevented by pruning back the laterals enough to subordinate them when the tree was young.

FIG. VII.

FIG. VIII.

FIG. VII.—A three-year-old Montmorency tree that was trained to an open center. The resulting sharp-angled crotch is likely to be a point of weakness as the tree grows older.

FIG. VIII.—A Montmorency cherry tree that is being trained to an open center. There is considerable space between the lowest and the highest scaffold limbs. A tree started in this way is not likely to develop a weak crotch, such as is shown in Figure VII.

has been used to a limited extent as a stock for the cultivated varieties but has generally proved unsatisfactory. The trees are likely to be short lived.

Size and Age of Tree—Both one- and two-year-old nursery trees are used in starting the cherry orchard. The younger trees are more commonly used in the case of the sweet varieties and the older ones when planting the sour and Duke varieties. Probably the older trees are to be preferred in the latter case, as the average one-year-old sour or Duke cherry tree is rather small for orchard setting. However, relative size and vigor is of greater importance than age. The smaller sizes can usually be purchased at a considerably lower price than the larger ones, but it may be questioned if it is good economy to buy them. They may turn out satisfactorily in the orchard. This is likely to be the case if their small size is due to a poor location or to crowding in the nursery row or to an unfavorable growing season; but if it is due to a weak seedling root it is likely to prove a permanent handicap. The best plan is to secure the best grade of nursery stock.

Time of Planting—In the Pacific Coast states and in the central and southern sections of the middle west and east, fall planting is recommended. It generally results in a more nearly perfect stand and the trees are likely to make more growth the first season. On the other hand, spring planting is preferable in the northern states. This is because fall-planted trees are more subject to root killing by cold where the soil freezes to a considerable depth. It is root freezing rather than freezing of the tops that is responsible for the trouble, however, and, paradoxical as it may seem, there are some of the most northern districts where fall planting is entirely

safe because of the protection afforded by snow that comes early and remains late. If, however, the fall-planted trees were stripped (i.e. had their leaves removed) in the nursery to permit early digging their tops may prove susceptible to injury to severe cold the first winter.

If planting is delayed until spring every effort should be made to plant as early as possible. The land should be plowed the fall before and setting should start just as soon as the soil dries out sufficiently in the spring. Delay in setting is probably responsible for the loss of more cherry trees the first season they are in the orchard than is all other factors put together. This is because cherry buds are inclined to open comparatively early and apparently cherry roots are a little slow in becoming established. The consequent losses of water from the tops cannot be supplied by the roots, the opening buds dry out, the wood and bark shrivel and the tree dies. All this can be avoided by planting before the buds start to open. This is one of the main reasons why fall planting is desirable in those sections where winter killing of roots is not a factor—the roots are sure to become established before there is any considerable demand for water on the part of the tops.

Handling Nursery Stock—The roots of cherry trees, like those of other fruits, are injured by drying out and by severe freezing. As a rule nursery stock is so packed and shipped that there will be little drying out and little freezing in transit, though shipments that are long delayed or that are shipped before the danger of severe temperatures is entirely passed may suffer. Most of the damage, however, usually comes after it has been delivered to the purchaser. Unless nursery stock is frozen when it arrives (in which case it should be put in a cold place where it

will thaw gradually), it should be heeled in promptly in moist but well drained soil in a cool shaded place. This will keep it from drying out and, if the temperature remains low enough, it will hold it dormant. If there is any likelihood of planting being delayed until the buds swell and start to open, it is desirable to hold the stock in cold storage, if such facilities are available. The three important things in its handling are: (1) to keep it from drying out, (2) to keep it from severe freezing, and (3) to keep the buds from starting to open. Perhaps there should be added here a suggestion to exercise especial care in handling. Cherry buds are somewhat larger than those of most deciduous fruits; they stand out more from the shoot and, consequently, they are easily rubbed or broken off in ordinary handling. This, coupled with the fact that young cherry trees do not form adventitious buds readily, often results in an uneven and unsatisfactory distribution of branches and difficulty in developing a well-shaped tree.

Planting Distances—Much has been said and written about planting distances for cherries. Recommended distances for sour cherries range from 15x15 to 25x25 feet or even more; recommended distances for the sweet varieties range from 25x25 to 40x40 feet. Everyone recognizes that in the first place planting distance varies with the variety. Sour cherries make comparatively small trees; sweet cherries sometimes grow to great size. Obviously trees of the sour varieties may be planted much closer than those of the sweet group. Furthermore, certain varieties, e.g., the English Morello, are much more dwarf in their growing habit than are other varieties, e.g., Montmorency, of the same group. A spacing of 16x16 feet probably provides as much room relatively for

each English Morello tree as a 20x20 feet spacing provides for an Early Richmond. There is, however, much difference in opinion as to what is approximately the best planting distance for any one variety, some claiming that relatively wide spacing results in better quality of fruit, larger trees and greater yield; others claim that larger yields are obtained with closer spacing and that there is little or no difference in grade of product. These claims, however, are for the most part based on theoretical considerations and general observation. Definite evidence on this question is furnished by the experience of a grower in northern Michigan who has kept the records of several different blocks of Montmorency trees that were planted at distances ranging from 16½x16½ feet to 23x23 feet. The closer planting, requiring 160 trees to the acre, resulted in a total yield of 93,393 pounds of fruit per acre during the first 16 years of the orchard's life; the wider spacing, requiring only 80 trees per acre, resulted in a total yield of only 72,482 pounds during the same period. Intermediate planting distances resulted in intermediate yields. There was no noticeable difference in the size or quality of the fruit. The individual trees in the wider-spaced block were larger and more productive than those planted closer together, but they were far from being twice as productive, which would have been necessary if their extra yield were to compensate for the closer planting. The difference in total production of 20,911 pounds to the acre at the end of the first 16 years would more than cover the cost of the land and the expense incident to purchasing and planting the trees and bringing them into bearing. The time might come when the annual revenue from the wider-spaced orchard equals or exceeds that from the one that is close planted but it may be

doubted if it would ever produce enough more fruit to compensate for its lower early returns. This particular grower has been employing close spacing in his newer plantings. A careful record of costs and returns would probably demonstrate to the satisfaction of many producers that somewhat closer planting would prove more profitable than the distances they now employ. A spacing of 15x15 feet is suggested as being suitable for English Morello and other distinctly dwarf growing varieties; 16x16 to 18x18 feet is suggested for varieties like Early Richmond and Montmorency; Late Duke might well be planted 20x20 feet; sweet varieties will probably bring the greatest returns if set from 24x24 to 36x36 feet, depending on variety and soil.

Planting—No special precautions are necessary in planting cherry trees. The holes should be large enough to accommodate the roots without bending or twisting; they should be deep enough so that the tree will stand as deep as or a little deeper than it grew in the nursery row; surface soil should be worked in about the roots and then tramped in firmly; finally loose earth should be drawn up over the packed soil to serve as a mulch. There is no occasion for mixing manure or commercial fertilizers with the soil that surrounds the tree roots at the time of planting. Seldom is it necessary to prune off or prune back any of the roots; if, however, some of the larger ones are badly bruised, it is desirable to cut off the bruised portions.

V

TRAINING THE CHERRY TREE

It has just been stated that it is seldom necessary to prune off or prune back any of the roots of cherry trees at the time of setting. Such a statement, however, does not apply to their tops. When the tree is dug most of its feeding roots and a large percentage of its conducting roots as well are left in the nursery row and it must begin its orchard existence practically stripped of its real absorbing organs. If planted without any top pruning, while it is still entirely dormant, it is practically without transpiring organs for the time being. However, with the opening of a relatively large percentage of the buds, the subsequent loss of water through the expanding leaves is likely to be much more rapid than the production of new rootlets and their intake of water from the soil. The result is that if planting is followed by a long period of hot dry weather, many trees dry out and die; or, if weather conditions are somewhat more favorable, the tree survives but water loss is regulated by water intake and growth is checked accordingly. On the other hand, if the tree is pruned back more or less severely at the time of planting, the growth of the roots can keep pace with that of the top from the very start, top growth apparently is not limited at any time by a lack of moisture and the tree makes a reasonably vigorous growth the first year (Fig. III). Failure to prune back the tops of cherry trees at the time of setting is second only to delaying

setting until after the buds start to open in causing the loss of trees during their first year in the orchard.

If the tree is a straight whip (as in the case of one-year-old stock) the pruning will consist simply in heading back to a height of 24 to 36 inches, depending on variety and size of tree. If it is a two-year-old tree with branches, pruning will consist in the removal of all but three or four of the strongest and best distributed branches and then in heading back those that are retained to a half to a fourth of their original length.

Methods of Training—Fruit trees are trained in a number of different methods or styles, the classification being based principally on the number, the distribution and the relative size of the different scaffold limbs. The three styles in most common use in America are known as (1) the open-center, vase, or goblet-shaped tree, (2) the closed-center, leader or pyramidal tree and (3) the modified leader tree. Typically these three styles are distinct but there are numerous gradations between them and frequently it is difficult to say whether some individual tree is of the one type or of the other. The natural habit of the sweet cherry is such as to lend itself readily to the leader type of training; that of most sour cherry varieties is such as to lend itself more readily to the open-center type. Most of the Duke varieties are intermediate between the other two types in their manner of growth and are as well suited to the one as to the other style of training. In practice a very large percentage of sour cherry trees are trained to open-centered form and about as many sweet cherry trees are trained to the one style as to the other. This does not mean, however, that open center training is necessarily best for sour cherries or that leader training is best for the sweet varieties. It is

simply a statement of what has come to be rather general practice.

The Leader Tree—The statement has just been made that most sweet cherry trees lend themselves readily to the leader type of training. Indeed most of them will assume this form of their own accord if simply left to themselves.

In the typical leader tree the trunk or central axis is the dominant feature of the tree's framework (Fig. 5). It extends clear to the top of the tree, giving rise to a relatively large number of lateral branches, no one of which is anywhere near as large as the trunk at the point from which it springs. These branches are usually well distributed, making a symmetrical, well-balanced top, round conic to pyramidal in outline. As there are a large number of branches, no one of which carries an unduly heavy load, and since they show a tendency to branch off at a rather wide angle, good shoulders are formed with the trunk, making a tree with a mechanically strong framework. Central leader trees are probably freer from splitting at the crotches than those of any other type. Their principal disadvantage lies in the fact that they are inclined to become taller than those trained in some other way, thus increasing the difficulty of thorough spraying and of harvesting operations.

In the case of trees possessing an upright growing tendency, training to the central leader type is an easy matter. Beginning with the two-year-old tree at the time of setting or with the one-year-old orchard tree, if a one-year-old whip was planted, the tree is pruned by first removing all of the lateral branches, except the two or three that are wanted for the first scaffold limbs. These are then pruned back to a length of six inches to a foot

or more, depending on their size and position, and the main stem or central axis is likewise cut back, but less severely than the laterals. In other words, it is given the lead, the advantage, over the other branches. In pruning the second, third and succeeding years the same general plan is followed. That is, there will be more or less thinning out or removal of superfluous, interfering shoots or branches—less in amount each year as the tree becomes older. There will also be some heading back of the laterals for two or three years and perhaps longer—enough heading back to keep the tree balanced and symmetrical. In the meantime the central branch or leader is allowed to grow as rapidly as it will, or, if it is pruned back, it is pruned back less severely than the laterals surrounding it so that it will continue to have an advantage over them and dominate the framework of the tree.

It is very important, however, that the leader maintain this advantage, this dominating position. If for any reason it fails to do so and the lateral branches start to outgrow it, it is very likely to be girdled and killed, resulting ultimately in an open center type tree with a bad crotch. This is what has happened in the tree shown in Figure 6.

Trees of a distinctly spreading habit, such as most of the sour varieties, can be made to assume the central leader type only with considerable difficulty. Indeed it is almost impossible to make leader trees out of some of them and what would be gained would not be worth the trouble. Their lateral branches tend to outgrow their leaders and it is only by relatively more severe pruning of these lateral growths year after year that any sem-

blance of a central leader can be developed and maintained.

The Open Center Tree—In training the open center or vase-shaped tree, the procedure is just the opposite from that employed in developing a tree of the leader type. Right at the start the central stem or leader, instead of being left unpruned or being pruned back less severely than the laterals, is removed entirely and all the growth forced into the lateral branches. The lateral branches are headed back less severely than in the leader type of training. A year later, and during succeeding years, any shoot or branch that develops in the center of the tree, grows vigorously and gives promise of assuming a position of leadership among the branches of the tree, is promptly removed. As in the case of the leader type of tree, superfluous growth of laterals is thinned out, but the terminal growth of the laterals is headed back only when necessary to restore and maintain balance in the top.

Characteristically open centered cherry trees are started with from three to five branches, all originating within a distance of six to twelve inches on the trunk. The vertical distance between the lowest and highest of these main branches is more frequently less rather than more than eight inches (Fig. VII). During its non-bearing and early bearing years such a tree appears to have an entirely satisfactory framework, but the centers of these scaffold limbs always remain the same distance apart and with their increase in size they gradually appear more and more as if originating at a single point on the trunk. Eventually a crotch is formed, the center of heavy strain in times of storm or periods when the trees are heavily loaded. Such crotches are points of weakness in the

framework of the tree and what normally happens is that sooner or later one or more of the limbs split down and the tree is seriously damaged or even ruined. The statement is ventured that, except for the immediate and residual effects of premature defoliation by the leaf spot disease, this one factor is more important than all others in setting the limit to the profitable life of the average sour cherry orchard.

In short, though the open center type of training is almost universally employed with the sour cherry, it generally results in a tree that is structually weak and defective and is not to be recommended. Indeed the only thing that it has to recommend it is that cherry trees are easily and commonly trained after this fashion. On the other hand, it is possible to develop an open center type of tree in which weak crotches are avoided and that is comparatively strong mechanically. This is done by selecting for the main scaffold limbs branches that originate from comparatively widely separate points on the trunk. Perhaps the lowest of these branches may be within two feet and the uppermost as much as four feet from the ground. Three years (two in the nursery and one in the orchard or one in the nursery and two in the orchard) may be required to grow the limbs from which such a selection may be made, but the greater strength of the tree more than compensates for the slight extra trouble that is involved. Figure 8 shows a Montmorency cherry tree that has been trained in this way. Sometimes, however, the upper one, two or even three scaffold limbs of such a well-spaced open center tree are girdled out by the more rapidly growing lower limbs, much as illustrated in FIG. VI, and an open center tree of the worst type results. This can be prevented by a somewhat more

severe heading back of the too-rapidly growing branches at the time that they start to outgrow those above them.

The Modified Leader Tree—Intermediate between the central leader and open center types of training is one of more recent introduction that is more or less accurately described by its name—the modified leader. In developing a tree of this type it is trained as a typical central leader for the first three to five years it is in the orchard, after which it is treated as an open center tree. The term "delayed open center tree," sometimes applied to this method of training, rather accurately tells how it is developed. It results in a tree with a comparatively large number of scaffold limbs but usually not so tall as one of the central leader type. Splitting at the crotch is largely avoided and the tree possesses practically all the advantages of the two types between which it is intermediate. Both sour and sweet varieties can be readily trained to this form and it is recommended as being the most practicable. In the case of the sour varieties it requires a little more care during the first four or five years in the orchard, as compared with the open center type of training, but it will add years to the life of the average orchard.

Subordinating Wayward Growing Limbs—Outside the care necessary during its first several years to start the cherry tree as a central leader, modified leader or open center tree, little training is required. Occasionally one side or one limb will start to outgrow the others and, if left alone, will result in more or less of a one-sided unsymmetrical top. An approach to this condition is shown in Fig. V. Such a limb can be subordinated and made to balance up with the other branches by cutting back more or less severely. Sweet cherry trees

that have grown so tall that spraying and harvesting become difficult and expensive should have their tops lowered by cutting back some of the more upright growing branches to strong growing laterals. Similarly, spreading or drooping branches of the sour varieties that come to interfere with cultivation should be cut back to horizontal or upright growing laterals or should be removed entirely.

VI

PRUNING THE BEARING CHERRY TREE

INCIDENT to training the young tree to the form in which it is desired to have it grow (See Chapter V) more or less wood is removed. During more recent years the tendency has been to remove as little as possible and still keep the tree developing its framework and top along the general lines of the style that has been chosen (FIGS. IX and X). The general effect of such treatment, as compared with more severe pruning, is to bring the tree into earlier and heavier bearing. Evidence on this question is furnished by the records of a Michigan grower who had two adjoining blocks of Montmorency trees growing on the same type of soil and given the same cultural treatments, except for the fact that the trees in the one block were given the customary moderate to heavy annual pruning (taking out cross branches and twigs where the tops appeared too thick) right from the start, while those in the other block were pruned lightly the first two or three years in order to shape them and were then left practically unpruned (See Table 5). The general ap-

TABLE 5. Yields of Montmorency cherry trees in adjoining blocks and receiving the same care, except for the fact that those in the one block were given a moderate to heavy annual pruning while those in the other block were pruned rather lightly.

AGE OF TREE YEARS	*Yield in pounds per acre where pruning was heavy*	*Yield in pounds per acre where pruning was light*
4	....	684
5	38	2,540
6	333	6,060
7	1,509	8,723

pearance of the trees themselves, as well as their yield records, showed clearly that the heavy pruning resulted in delaying bearing by two or three years and in greatly reducing the size of the early crops. Indeed there was every indication that the heavily pruned trees would remain about three years behind those that were pruned more lightly. Counting all expenses and deducting returns the one block represented a net investment of $614.00 per acre at the end of seven years; the other block had already paid for all of its maintenance and development costs and left the owner a clear profit of $216.00. This is an almost unbelievable difference to attribute to the influence of a single cultural practice, but the figures are authentic. Probably the difference is more extreme than would be found to be the case under average conditions. There is reason to believe, however, that the principle that they serve to illustrate has rather general application in the cherry industry and that many young cherry orchards are far less profitable than they otherwise would be because they are overpruned.

Bearing Habits of the Cherry—The reasons for the influence of moderate to heavy pruning, first in delaying fruiting maturity and later in reducing yield, become apparent when one studies the bearing habits of the cherry tree.

Long, strong shoots, such as characterize young vigorously growing trees of both sour and sweet varieties, possess vegetative buds only (See Fig. XI). When these buds open in the spring they give rise to new shoot growth or to spurs, if only a very limited amount of growth is made. If the shoot in question has been rather severely pruned, or if the tree as a whole has been severely pruned, the new growth will be principally shoots that,

like the ones from which they sprang, are vigorous and that in turn bear only leaf buds. Successive seasons of heavy pruning are followed by successive seasons of strong vigorous shoot growth that bears only vegetative buds that grow out to form new shoots. Each season sees only a few short growths (fruit spurs) formed and these are usually several years in coming into bearing because of the dense shade above and about them. If, on the other hand, pruning is less severe, shoot growth will be somewhat less vigorous, a smaller percentage of the buds will grow out into shoots and a larger percentage will develop into spurs. Bearing area is thereby greatly increased and earlier and heavier production is possible.

In many of the sour varieties early and heavy bearing is still further promoted by light or no pruning because of the fact that medium to short, as contrasted to long, shoots form lateral fruit buds instead of leaf buds (FIG. XI). This results in their bearing directly on their shoots instead of indirectly on the same wood only after the intervening of another one or two years of spur growth. Indeed, some varieties, such as the English Morello, are very prone to bear in that manner and this general difference in bearing habit is one of the main factors responsible for varietal differences in age of bearing. In general the situation may be summarized by saying that a very vigorous type of wood growth, which is encouraged by heavy pruning, tends to reduce or prevent fruit bud formation on shoots and to reduce the number of fruit spurs, at the same time increasing the amount and proportion of shoot growth which bears leaf buds only or principally. On the other hand a more moderate type of wood growth, which is encouraged by light as opposed to heavy pruning, tends to promote fruit bud formation on

FIG. IX.

FIG. X.

Fig. IX.—A three-year-old Montmorency tree. This tree has made a moderate amount of growth, before pruning. Compare with Figure X.

Fig. X.—The same tree shown in Figure IX. after pruning. The pruning has been limited to the removal of a few branches. Heavier pruning at this stage delays bearing and reduces yields.

FIG. XI.—SHORT, MEDIUM AND FAIRLY LONG MONTMORENCY SHOOTS WITH CORRESPONDING LENGTHS OF TWO-YEAR-OLD WOOD.

Note that the longest shoot bears only narrow pointed leaf buds and that its last year buds, of the same kind, have grown out to form stocky vigorous fruit spurs. Note that the shortest shoot bears only plump rounded fruit buds and that its last year buds were of the same kind, a fact evidenced by the scars left when the blossoms or fruits that they produced fell off or were picked. The shoots of intermediate length show characteristics of both short and long shoots.

shoots, to increase the numbers of fruit spurs and to reduce the amount of shoot growth that bears only leaf buds.

It may be noted that, incidental to encouraging a more vigorous shoot growth, more or less heavy pruning results in a relatively smaller amount of flower bud and fruit formation on shoots and correspondingly more on spurs, in the case of those varieties that tend naturally to bear a part of their crop in the former way. It makes little or no difference in this respect in the sweet varieties, since they bear almost exclusively on spurs, regardless of their pruning or other cultural treatments.

When cherry trees of full bearing age are pruned, more or less bearing wood (or, if the pruning is limited to shoots only, potential bearing wood) is inevitably removed. This results in a reduction in number of flower buds, flowers and fruits and likewise in a corresponding reduction of total yield. Theoretically there might be no reduction in yield if the remaining blossoms set fruit enough better or if the fruits that matured grew enough larger to compensate for the reduction in number. Practically, however, this never occurs and reduction in yield is closely proportional to severity of pruning. This is well illustrated by the records obtained in a Montmorency orchard where light to moderate pruning was employed on part of the trees (Fig. XII). The average annual yield of the unpruned trees over a four-year period was 109 pounds, that of the pruned trees during the same period was 101 pounds. Heavier pruning undoubtedly would have resulted in still greater reduction in yield.

Furthermore, pruning is unnecessary in the cherry orchard from the standpoint of improving fruit coloration. The fruit will take on its characteristic color when

it becomes mature regardless of whether any direct sunshine reaches it or not.

Unpruned or very lightly pruned cherry trees, especially of the sour varieties, get thick and brushy as they become older, resulting in more or less interlacing of branches and the dying out of fruiting wood in the interior of the tree. It is somewhat more difficult to spray thoroughly both fruit and foliage in a tree that is thick and brushy than in one that has been kept open by regular pruning. Consequently there is the possibility of greater loss from insect and fungus attack. This, however, is compensated for, at least in part, by the fact that there is less wind bruising in the thicker topped trees.

The long-established idea that cherry trees, as compared with those of most other fruits require little pruning is based on sound principles. However, it should not be inferred that no pruning is desirable. Dead wood and broken limbs should be removed and the early removal of one of two or three interfering branches may avoid the necessity of considerably heavier pruning several years later. Furthermore, continued neglect of pruning or practicing very light pruning for a period of five to ten years is likely to result in the gradual dying out of the interior branches and crowding the fruiting wood further and further away from the center of the tree, resulting in placing a heavy strain on its framework and consequent danger of breakage. To avoid this danger and renew the top of the tree it may be necessary to cut back the top severely once in every six to ten years. This is essentially a renewal pruning, a dehorning. It sacrifices the most of one crop and the yield the following season will be somewhat below normal, but if advantage is taken of a season when there has been serious winter-

killing of blossom buds or serious loss of blossoms from frost, the loss will be relatively small. For most varieties and most conditions it is the most practicable type of pruning in the mature cherry orchard. There are, however, conditions where exceptions should be made. For instance, it has been found that in some sections where winter temperatures are unusually severe there is less killing of buds on spurs than on shoots. In other words the spur-borne are hardier than the shoot-borne fruit buds. Where this is true, moderately heavy annual pruning to increase the proportion of spur buds may be advisable, even though it may result in a smaller total number of fruit buds. In general, however, soil management methods, rather than pruning, should be depended on to promote and maintain a moderately vigorous to vigorous type of growth in the cherry tree.

VII

SOIL MANAGEMENT METHODS

If one were to judge the tillage requirements of the cherry by what he sees employed in the commercial plantations, he would conclude that a clean culture or a clean culture-cover crop method of soil management is essential to success. On the other hand were his opinion to be based on observations of cherry trees growing in home orchards and about the home grounds, he would be equally sure that cultivation of the soil is not essential in cherry culture and furthermore that a sod method of soil management is to be recommended. At least practically all commercial cherry orchards are cultivated and a comparatively large percentage of the amateur's trees, which seem to thrive almost as well as those of the commercial producers, are standing in sod.

Cultivation—There is little doubt but that under most conditions the cherry does better under a clean cultivation-cover crop system of culture than under any other system of soil management. The almost universal adoption of this system by commercial growers is sufficient evidence on this point. It is a method of soil management that promotes a rapid vigorous growth and that leads to heavy yields of large sized fruit when the tree is once well into bearing. Its main disadvantages lie in the fact that it delays somewhat the coming into bearing of the tree and in a few cases it may result in a late summer growth and consequently in a greater sus-

ceptibility to winter injury. These disadvantages are greatly overbalanced, however, by the advantages. Seldom does the delayed maturity of the tree amount to more than one or two years and the larger crops of the cultivated trees will soon compensate for this delay. Furthermore, it is only when cultivation is continued unnecessarily late in the season that there will be any noticeable difference in the hardiness of sod-grown and cultivated trees.

Clean culture usually consists in a shallow plowing or discing early in the spring, followed by several cultivations with spring or spike-toothed cultivators at frequent enough intervals to destroy weeds. The last cultivation is usually given during the latter half of July, after which a cover crop is sown or weeds are allowed to grow in their place for soil mulching purpose and to form a winter cover. It is important that the cultivation be shallow, because deep cultivation destroys many of the roots and serves to check tree growth. If many of the roots are destroyed at or just before the time of fruit setting, it is likely to interfere with that process and materially reduce the crop. For that reason many growers plan either on plowing or discing their orchard before the blossoms open or wait for these operations until after the fruit has set. In either case the roots are left undisturbed during one of the most critical periods of the year.

Cover Crops—Cover crops are desirable in the cherry orchard primarily from the standpoint of contributing to the supply of organic matter in the soil, thereby improving its physical condition, increasing its water-holding capacity, preventing erosion and adding to its fertility. In the more northern states they also serve to protect

the ground from such deep and severe freezing as would otherwise take place, thereby lessening the amount of winter injury to the roots. This is partly through their direct blanketing effect and partly through their ability to hold snow. They also help to mature the wood of the trees in late summer and fall by utilizing some of the moisture and soil nitrates that otherwise might be taken up by the trees and force a late growth on their part.

The most important requisite of a cover crop is that it shall be rapid growing. Its value depends largely on the volume or weight of material that is produced, and, the more of this that can be produced before the advent of cold weather, the better. Spring growth is just as good as fall growth from the standpoint of adding organic matter to the soil, but it does not serve to protect the soil during the winter. It is also desirable that the cover crop plant be one that is killed by winter freezing. A cover crop that survives the winter and makes a rapid growth in the spring requires considerable quantities of water and of soil nutrients in the spring and becomes a serious competitor with the trees for them. This may not be a factor of importance in some seasons or in some places but it becomes serious when the spring turns off dry. For this reason it is desirable to disc or plow the cover crop under before rather than after blossoming if a winter-surviving crop, like rye or rye and vetch, is sown. Oats, millet, buckwheat, soy beans, field peas and cow horn turnips make good cover crops.

Irrigation Requirements—The entire eastern cherry crop and much of that produced in the Pacific Coast states is raised without the aid of irrigation. This does not mean that the cherry is particularly drought resistant, though it can be grown commercially with a more limited

water supply than most other tree fruits. One reason for this ability to get along on a somewhat limited water supply may be the fact that the crop matures in mid-summer and, during the late summer and fall months when other fruits are requiring comparatively large quantities for developing the fruit and perhaps making some vegetative growth, the cherry requires little more than simply a maintenance ration. Indeed cherries are raised successfully without irrigation in some areas where the yearly rainfall averages only 15 to 18 inches. Where, however, the total precipitation is much short of that amount some irrigation is necessary.

A moderate soil moisture supply shortly before and during the ripening period helps the fruit attain large size. A relatively abundant supply at that same period is likely to lead to cracking of the fruit, especially in case of the sweet and Duke varieties. Rains or irrigation just before or during harvest are therefore not desirable. The rains cannot be prevented but irrigation at that time can and should be avoided. High atmospheric humidity at the same period likewise leads to more or less cracking. For this reason the sweet varieties are generally grown more successfully in arid or semi-arid than in humid regions.

Sod Culture—The statement has been made that, though practically all commercial cherry orchards are tilled, a comparatively large percentage of the amateur's trees are in sod and, furthermore, they seem to thrive in it. Indeed cherry trees seem to stand more neglect in this respect than those of most other fruits. Grown in this way they make somewhat less growth and produce somewhat smaller crops than trees that are cultivated. They are, however, distinctly less susceptible to winter injury, partly because their wood matures earlier and

better and partly because the sod affords some protection to the roots. Observation leads to the belief that because of this apparent difference in hardiness it might be practicable in some of the more northern states to put the sweet cherry under a sod mulch method of management. The trees would probably be considerably longer lived.

Fertilization—For many years the opinion was generally held that cherries require little or nothing in the way of fertilizer applications. It is only within recent years that reliable experimental evidence on this question has been available. This evidence is being supported by the experience of a number of the best growers. In general it indicates that, of all the various nutrient materials supplied by fertilizers, nitrogen alone is likely to produce a response in the tree that makes its application profitable. Other materials may prove valuable in some instances from the standpoint of promoting a better growth of the cover crop, though the trees themselves show no direct response to them. Applications of nitrogenous fertilizers often result in a greatly increased vegetative growth and in doubling, tripling or even quadrupling the crop.

The two fertilizers most commonly used are nitrate of soda and sulphate of ammonia, though apparently some of the newer materials such as calcium nitrate and urea are equally satisfactory. No hard and fast rule can be given as to how much of these materials to apply or as to whether to apply them at all. In general it may be stated that the young non-bearing trees of most sour varieties should make an annual shoot growth of 15 to 24 inches and the sweet varieties should be making half as much more growth. Bearing trees of the sour varieties should be making a new shoot growth of 8 to 12

inches and sweet varieties a corresponding amount. Failure to make these amounts of new growth is evidence of a lack of soil fertility, (though sometimes drought and certain forms of winter injury lead to the same symptoms) and fertilizer applications should be tried. Seldom will it be desirable to use more than one pound of nitrate of soda on trees that have not yet reached bearing age. After the trees have reached full bearing, however, as much as three to five pounds apiece may often be used to advantage. Overvigorous shoot growth and uneven ripening of the fruit are the two symptoms that indicate too much nitrogenous fertilizer is being used. Probably the more that is used in orchards of bearing age, up to the point where uneven ripening makes necessary two or more pickings, the more profitable does the orchard become.

Fertilizer applications are generally made to best advantage in the spring just before blossoming. The material should be broadcasted on the ground about the trees a little further than the spread of the branches.

Where barnyard manures are available they make an excellent fertilizer for the cherry orchard, adding to the humus as well as to the nutrient supply of the soil.

The question is often raised as to the necessity or desirability of liming the cherry orchard. The available evidence indicates that the cherry thrives in somewhat acid as well as in neutral soils. Probably there are very few cherry orchards where liming is warranted from the standpoint of any direct benefit to the trees. There may be instances where it is desirable from the standpoint of promoting a more luxuriant growth of the cover crop.

Fertilizer applications, even though liberal in amount and made annually, will seldom make trees growing in a light infertile soil grow as vigorously and produce as

heavily as they will without fertilizer applications in a soil that is naturally rich and deep. They will, however, go far toward compensating for its deficiency in fertility and are often the means of making an orchard profitable that otherwise would be so unproductive as to be a distinct liability.

VIII

FRUIT SETTING

THOUGH the practice of artificially providing for the cross pollination of the fig and the date palm was well established over 2,000 years ago, it was not until the middle of the last century that this problem was brought to the attention of American fruit growers, because of the failure of certain strawberry varieties to set fruit properly, and it was not until the beginning of the present generation that it was realized that pollination may be a serious problem in the tree fruit industry. At that time pear growers in some sections of the country where large blocks of single varieties had been planted were failing to secure crops of the size they would expect from the numbers of flowers that the trees bore in the spring. Discovery of the cause and the remedy for this situation in pear orchards led to discovery of the same problem, perhaps in less acute form, in many apple orchards and vineyards and, in general, to the adoption of the same methods of dealing with it in the case of those fruits.

It was not until about 15 years ago, however, that it was realized that the cherry presents a pollination problem. It was assumed, of course, long before that time that cherry blossoms must be pollinated in order to set and mature fruit, but it was likewise assumed that wind, insects and perhaps other agencies would naturally and automatically provide for the necessary pollination. Cherry trees had always borne what was considered sat-

isfactory crops for the conditions under which they were growing, or, if failure occurred, it was attributed to other causes. About 1911-13, however, some of the sweet cherry growers in Oregon were beginning to comment on what seemed to be inexplicable repeated failures of their trees to bear satisfactory crops. Investigation by one of the Oregon Experiment Station staff members revealed the fact that some of these orchards where there had been failures consisted of a single variety and the known facts regarding the self-sterility of some of the other fruits suggested self-sterility as the possible cause of the difficulty in these cases. A series of controlled hand-pollination experiments verified this explanation of the situation and led to the discovery that apparently all varieties belonging to the sweet cherry group and at least some of the Duke varieties are sterile to their own pollen. That is, though they are abundant pollen producers and though their pollen is good in the sense that it will cause fruit setting and the proper maturing of the fruit when applied to the pistils of most other sweet cherry varieties, their pollen is without value on their own pistils. These conclusions have since been substantiated by the results of similar experimental work in England, Holland, Sweden, California and several of the eastern states.

Intersterility—In addition to being self-sterile, some of the sweet cherry varieties show intersterility. That is, they fail to set and mature fruit when pollinated by certain other varieties, though the pollen of these other varieties is perfectly satisfactory when used on most varieties. It has been a very unfortunate coincidence that the three leading sweet cherry varieties grown on the Pacific Coast—Napoleon, Lambert and Bing—have proven to be intersterile, because large mixed plantings

of them were made before this was known. Except for these three, apparently the commonly grown varieties are interfertile and can be safely interplanted.

One thing that has led cherry producers to ignore the pollination problem for so long, indeed that has caused them to fail to recognize it as a problem, is the fact that many self-sterile varieties appear to set their fruit when there is no provision for cross pollination. That is, the fruit starts to develop after petal fall and perhaps may become a third or a half grown before it turns yellow, shrivels and falls off. In some instances it reaches two-thirds the size of the mature fruit before dropping. Failure at such a late stage in its development has usually been attributed to other causes, though investigation has shown that more often it is due to unsatisfactory pollination. It is more or less comparable to the so-called "June drop" of the apple and pear.

Interplanting for Cross Pollination—The remedy for self-sterility in cherries, as with other fruits, is the interplanting of two or more varieties so that cross pollination can be effected. No sweet cherry variety should be set in a solid block by itself and, in the absence of definite information to the contrary, single varieties of the Duke group should not be set by themselves. Two or more varieties can be planted in alternate rows, or, if it seems desirable to have as many trees of one variety and as few of the other as possible, one can plant three to four rows of the main kind and then one row of the pollinizer. If one wishes to reduce the number of trees of the pollinizing variety to a minimum, every fourth tree in every fourth row could be set to that sort, though every third tree in every third row would give more satisfactory results.—If the variety that is being planted

is Napoleon, Lambert or Bing, some variety other than the other two should be used for pollinating purposes, since these three are intersterile.

Many sweet cherry orchards supposedly planted originally to a single variety or to two or more intersterile varieties have proven reasonably productive, thereby apparently disproving the idea that all varieties are self-sterile and that certain ones are intersterile. Careful examination of these orchards, however, almost invariably discloses the fact that a few trees of some other variety or that a few seedling trees are mixed in with the others. Though the fruit that they bear may be of an inferior kind or even practically worthless, the chances are that in one sense they are the most valuable trees in the entire orchard, for without them the trees of the desirable kinds would be unproductive. Indeed these stray trees, the result of some nurseryman's mistake, have proven the salvation of many a sweet cherry orchard enterprise.

Thus far both circumstantial and experimental evidence indicates that the more common sour cherry varieties are self-fruitful and that they are not benefited by interplanting. This statement cannot be made for all sour cherry varieties because definite pollination experiments have been conducted with only a comparatively few. One need have no hesitancy, however, in planting Early Richmond, Montmorency and English Morello in solid blocks, though the results of tests in some sections have indicated that even these varieties are likely to bear better when interplanted with one another than when set alone.

A very limited amount of experimental evidence indicates that the sour varieties are not satisfactory pollinizers for sweet varieties. Some of the Duke varieties

are satisfactory as pollinizers for the sweet varieties and similarly some of the sweet varieties are satisfactory pollinizers for some of those of the Duke group, but only a limited amount of information is available on the pollination requirements of the Duke group.

Temporary Pollination Expedients—Orchards that have been planted to a single self-sterile variety or to two or more intersterile varieties, and that consequently are unproductive, can be dealt with by each year bringing in flowering branches (bouquets) of other varieties during their blossoming season and standing them in buckets or tubs of water to keep them fresh. Bees and other insects will carry pollen from the flowers on these "bouquets" to the flowers on the trees. Proper pollination being thus effected, the fruit will set and mature. The larger, more numerous and better distributed such bouquets are, the better are the results that will be obtained. Yields have been increased manyfold in plantings of commercial size by this simple and inexpensive expedient. It is obviously a temporary measure and must be repeated each year. For permanent results a sufficient number of trees (not less than every fourth tree in every fourth row) can be top worked to a suitable pollinizing variety. As soon as the new tops come into heavy bearing the introduction of "bouquets" can be discontinued. Cherries are not top-grafted quite so easily as some of the other fruits but if a little care is taken good results can be obtained.

Bees in the Cherry Orchard—Many fruit growers believe that pollen is carried from flower to flower and from tree to tree by the wind. This is true in the case of many of the forest trees; it is true of grape vines and of many other plants. It is not true, however, of the

common tree fruits. The cherry, along with the apple, pear, peach and plum, is insect pollinated. Wild insects of many kinds seek the nectar of cherry blossoms and serve to carry pollen from one flower and from one tree to another. The honey bee, however, is probably more important in this connection than all the wild forms put together. Orchards that have been suitably interplanted from the standpoint of cross pollination but that without bees have borne comparatively small crops have had their yields doubled, tripled and even quadrupled by simply placing in them a number of colonies of bees during the blossoming season. Furthermore the evidence indicates that bees are almost as essential to securing a good setting of fruit in an orchard planted to self-fertile as it is in the case of an orchard set to self-sterile varieties. For instance in one test where a Montmorency cherry tree (self-fertile variety) was enclosed in a screen cage to exclude bees during the blossoming season, only 2.4 per cent of the flowers set and matured fruit, while in adjacent trees outside the cage and open to pollination by bees that were abundant 15 per cent of the blossoms set and matured fruit. The cherry grower may not need to be a bee keeper but if neither he nor his neighbors keep bees he should rent or otherwise make provision for them.

No exact rule can be given as to how many colonies of bees are necessary to provide for an orchard of a given size. If the colonies are small and the blossoming season short or cool and rainy and if the trees are fully grown more will be required than otherwise. A conservative estimate would be at least one colony to three acres of orchard. One colony to each acre would practically insure adequate pollination if weather conditions were even

half favorable. At a rental of five dollars per colony (and bees can often be rented at a lower figure) this investment would pay for itself many times over in a large number of cherry orchards.

Fungi and Other External Factors—Not all failure of the blossoms to set and develop fruit, however, is due to lack of pollination or to improper pollination. There is reason to believe that serious disturbance of the roots during the blossoming and fruit setting period, as by deep cultivation, causes many blossoms to drop without setting. More important still is the attack of certain fungus diseases, especially the brown rot. If it is unusually hot and humid during the blossoming period, losses from this cause are likely to be especially serious. They have been known to run as high as 90 per cent of the blossoms. In those districts and with those varieties where losses of this kind are likely to be frequent and heavy, thorough spraying with a fungicide just before blossoming has proven an effective control measure. It should be mentioned in this connection, however, that spraying itself sometimes leads to a shriveling and premature dropping of the fruit, sometimes directly and sometimes indirectly. This may be brought about by a caustic or burning effect on the pedicels or stems of the developing fruits of some of the later applications, through which lesions fungi of various kinds may gain entrance to the live tissues. The fruit is thus cut off from its water and nutrient supply. English Morello seems to be especially susceptible to this type of injury. Prevention lies in substituting some of the less caustic materials, such as wettable sulphur or the dry-mix sulphur-lime for the standard lime-sulphur in the later application.

IX

WINTERINJURY

ATTENTION has been directed to the fact that the cherry is one of the hardiest of fruits. Especially is this true of the sour cherry which has been known to survive winter temperatures more extremẽ than those withstood by many of the best apple varieties. Nevertheless the cherry tree, in common with other tree fruits, is subject to a number of different forms of winterinjury. Indeed it may be said that winterinjury is probably a more important contributing factor in determining the longevity of the cherry tree than is true in the case of any other fruit. Furthermore, its direct effect through bud killing on the size of the following crop and indirectly on many succeeding crops through injury of one kind or another to the wood, makes it a factor second in importance to hardly any other in determining the profitableness of the cherry enterprise. This is well illustrated by the record of a sweet cherry orchard in the Willamette valley of western Oregon (See Table 6). This orchard of 15 acres, part of which was set in 1896 and the remainder at varying intervals up to and including 1914, was for a number of years regarded as one of the outstanding cherry blocks of the state. Then came the severe cold of the 1924-25 winter. The 1925 crop was less than a tenth of that of the preceding season. That the trees themselves suffered irreparable injury is indicated by the fact that none of the three succeeding crops

have quite equalled half that produced in 1924, though the trees are older and larger and more could be expected of them. In the spring of 1929 the owner of this orchard wrote: "Our orchard was badly damaged by freezing in the winter of 1924-25. We lost a number of trees and a great many limbs from others. The oldest trees were injured most. . . . We are still losing a great many fruit spurs."

TABLE 6. The fruiting record of a 15-acre sweet cherry orchard in western Oregon, injured by the severe cold of the 1924-'25 winter. Part of the orchard was set in 1896 and the remainder at varying intervals to and including 1914.

YEAR	*Yield in tons*
1920	53
1921	Record not available
1922	Record not available
1923	22½
1924	67
1925	6½
1926	32½
1927	32½
1928	15½ *

* Some frost injury to blossoms in the spring.

From these statements it is evident that it is desirable for the grower to learn to recognize the different forms of winter injury as they appear in the cherry orchard, and that he become acquainted with the conditions under which they are most likely to appear and both preventive and remedial methods of dealing with them.

Sunscald—Though usually less serious in the cherry orchard than with most other tree fruits, sunscald of trunk is of rather frequent occurrence, especially in the more northern districts where the sun's rays, reflected from the snow, lead to extreme variations from night to day in bark temperatures on the south and southwest

sides of the trunk. The sudden and severe freezing at nightfall is apparently the cause of the trouble. Possibly a contributing factor is the high temperature to which the trunk tissues are subjected rendering the cambium more subject to injury from cold. Anyway the result is a localized killing of the affected tissues. This is most likely to occur during late winter, though the injury will probably not be recognized until some time during the following summer when the normal growth of the healthy surrounding tissues leaves a dark colored sunken area where bark, cambium and wood are dead. If the dead area is small it will usually callus over and no permanent harm will come to the tree. On the other hand if the area is extensive, healing takes considerably longer and in the meantime wound fungi are likely to gain entrance to the heart wood and lead to the early death of the tree. Sunscalded areas should be promptly cleaned and covered with a wound paint or grafting wax, to keep the wood from drying out and being invaded by fungi. The low heading of cherry trees aids in preventing sunscald by affording the trunks a certain amount of shade. Indeed the high heading of cherry trees is always to be avoided, for this reason if for no other. In practice no tree is headed higher and with less excuse and to more grief than the sweet cherry. In sections where considerable trouble from sunscald is experienced the trees should have their trunks shaded with a board or shingle placed against their southwest sides, either driven into the ground or nailed to the trees. Whitewashing the trunks is also a fairly effective preventive measure.

Occasionally another type of sunscald is met with in the cherry orchard. This too is found on the south or southwest sides of the trunks and close to the ground. In

appearance it looks much like the sunscald that has just been described. However, it occurs at a different season of the year and is not associated with freezing temperatures. It is caused by the reflected heat of the sun's rays in midsummer, producing lethal temperatures in and underneath the bark. It is most common on southern slopes and light sandy soils. Both preventive and remedial measures are the same as for winter sunscald.

Sunscald is most serious while the orchard is getting established. When the trees get to be five or six years old their tops usually shade the trunks to such an extent that extreme variation between night and day temperature of the bark is avoided. Furthermore, as the bark becomes thick it affords considerable protection against rapid temperature changes in the underlying tissues.

Bark Splitting—A form of winter injury rather common in the sweet cherry, though less frequently met with in the sour cherry, is bark splitting. These vertical cracks or splits occur anywhere on the trunk, though usually near the ground. They vary from an inch or two to eight to ten inches in length and extend clear to the wood and they may be a quarter inch to half inch wide. Unless dealt with promptly the exposed edges of the bark are likely to curl outward, exposing a considerable area of wood. The exposed tissue soon turns brown and dies and healing may be slow. Bark cracks occur on both young and old trees, though perhaps more frequently on young trees that have been growing vigorously. Cultural practices that tend to promote a late growth of the wood render the trees more susceptible to the trouble. The injury generally appears in late fall or early winter when there is an unusually severe drop in temperature. Prevention lies principally in so growing the trees that they

complete their new growth reasonably early and go into the winter in a fully mature condition. The most practicable remedial measure is to tack down the edges of the bark so as to reduce to a minimum the drying out of both wood and bark and to promote healing of the wound. This should be done promptly. If it fails to unite it should be cut back to where the bark is solidly attached.

Bark splitting is seldom in itself a serious matter but it is frequently accompanied by another form of winter-injury, blackheart, that is serious; hence the urgency of covering the wounds.

Bark splitting that is caused by low winter temperatures should not be confused with normal growth cracks due to gradual increase in size of trunk or limb. These latter are usually less regular, with more ragged edges and are not so deep as freezing cracks. The bark shows no tendency to separate from the wood and curl up at the edges and the cracks usually appear when growth is starting in the spring, rather than in late fall or winter.

Blackheart—The term blackheart describes fairly accurately what is perhaps the most characteristic symptom of a form of winterinjury that is serious in the cherry. The heartwood of the affected trees is not exactly black, but it is distinctly darker than that of sound healthy trees. Where the injury is mild and of recent occurrence the discoloration varies from orange to light brown. In more severe cases and in those of long standing it is likely to be a darker brown to almost black. This discoloration is likely to be found in spurs, shoots of the past season, small and large branches and in the trunk. Furthermore, it often extends from the center almost to the outer edge of the woody cylinder, leaving a very thin layer of normal

healthy sapwood. Indeed the injury, when it occurs is to the sapwood; but, when growth is resumed in the spring, a layer of healthy wood is formed on the outside of that which is injured, more or less completely sealing it in.

The darker color of the blackhearted tissues is not in itself a cause for alarm, but it is correlated with their killing and a loss of at least some of their functions. This dead wood may be as strong (for a while) as that which has never been injured but apparently it loses much of its ability to conduct water from roots to tops and the food materials that were stored in it at the time of the killing become locked up here so that they are rendered unavailable for subsequent growth processes. The result is that the tree is greatly weakened because of what amounts practically to this loss of food materials and furthermore the top is deprived of its normal water supply, even though there may be an abundance of moisture in the soil. Consequently blackhearted trees soon come to show symptoms of both drouth and starvation.

If conditions following an occurrence of blackheart are favorable for growth and practically such as to preclude any recurrence of the trouble, the tree is very likely to outgrow the injury, especially if it has not yet reached bearing age. On the other hand experience shows that conditions favoring this type of injury are of rather frequent occurrence and trees once injured are likely to be even more susceptible to it than they would have been otherwise. Furthermore blackhearted tissue is especially susceptible to attack by wood rotting fungi which gain entrance through pruning and other wounds. Blackhearted trees are thus very likely to become rotten hearted and be weakened mechanically. Furthermore some of the fungi which first start to work as saprophytes

on the dead winter-killed wood in the center of the tree have the ability to become true parasites and spread into the live sapwood. In many cases this spread of the parasite from within just about keeps pace with the formation of new wood on the outside, the result being that, though theoretically recovery should be fairly rapid and complete, real recovery never occurs. The blackhearted tree may continue to live for a number of years, but it is low in vigor, produces only a small amount of low grade fruit and is in most cases a liability instead of an asset. Many growers, not realizing the real nature of the trouble affecting their blackhearted trees, try to nurse them along, hoping that they will recover, but almost invariably the outcome of such efforts is a lingering death. It is safe to say that in the northern sections blackheart is the direct or main contributing cause of the death of more cherry trees than all other factors put together and that it is the most important factor in determining the average life of the cherry orchard.

Characteristically blackheart is a late fall or early winter form of winterinjury, though it may be brought on by severe midwinter freezing. A hard freeze in late fall, when the tissues are rather poorly matured, is favorable for its occurrence. Trees which have been forced to make an unduly late growth, either by the use of fertilizers, late tillage, irrigation or heavy pruning are especially susceptible to this form of winterinjury. It is common in nursery trees that have been forced to grow too rapidly. Probably the most common and most important factor contributing to the occurrence of blackheart is premature defoliation caused by the leaf spot or shot hole fungus. Trees that have lost their leaves prematurely do not ripen their wood properly and go into

the winter in a comparatively tender condition. Even the moderate cold of an average winter is likely to cause blackheart in the immature wood of such trees. Thus it happens that the widespread occurrence of blackheart is more frequently an aftermath of leaf spot epidemic, than it is of winters unusual in their severity.

The statements that have just been made describing and explaining the conditions under which blackheart is most likely to occur suggest at once a number of preventive measures. Cultural treatments should be such as to induce a reasonably early maturity of wood. Even more important, from the standpoint of maturity, is proper spraying to control leaf spot and prevent premature defoliation. Only in nurseries and in young orchards growing on a rich moist soil is there much likelihood of the trees growing so vigorously and so late that they fail to acquire a proper degree of maturity before the onset of cold weather; but the menace of premature defoliation because of fungus attack remains as long as the trees are alive.

Remedial measures are not very satisfactory. Sometimes they are effective, sometimes not. Liberal applications of barnyard manures or of nitrogenous fertilizers may help the tree outgrow the injury. If, however, wood rotting fungi gain entrance to the dead tissues and then spread outward into the new layers of sapwood, fertilization is of little avail. For this reason it is better to do no pruning in blackheart trees, thus eliminating one of the principal channels through which infection occurs. In any event, if pruning is delayed a year or two, wound healing will be more rapid.

Dieback—Dieback is another form of winterinjury that is more or less accurately described by the term

itself. In the cherry it is likely to be localized in the tree, that is, it is more likely to affect individual branches or limbs, than to be general throughout the top. This is in contrast to the situation usually found in the peach where a dormant season killing back of the ends of the last season's shoots is more or less common and is more or less evenly distributed throughout the entire top. Both of these forms of dieback are associated with immaturity of the affected tissues but the immaturity in the case of the peach shoots is usually associated with their late growth while that of the cherry twigs is commonly due to a premature defoliation by leaf spot or spray injury or other causes. Localization of the dieback in the tree is explained by the fact that uneven spraying often results in control of the leaf spot disease on some of the limbs and a failure in control on others. Dieback is rather commonly associated with blackheart, though there may be little or no evidence of blackheart in some of the limbs showing dieback. Furthermore trees may be affected with blackheart for several years before dieback symptoms appear. In the later stages of blackheart, however, there is more or less dying back of limbs (Fig. XIV).

As may be inferred, the same cultural and spraying measures that should be employed to prevent blackheart injury are likewise effective in protecting against dieback. Remedial treatments are, at best, unsatisfactory. They consist in the removal of dead branches and in stimulating new growth through good tillage and fertilizer applications.

Crown and Crotch Injury—Killing of the bark tissues in the crotches and at the crown is a form of injury often associated with immaturity. It is occasionally met with in the sour cherry orchard and somewhat more fre-

quently in sweet cherries but relatively it is of less importance than it is in the case of some of the other tree fruits. Protecting the wounded areas from the entrance of moisture and decay organisms and thus giving them the best opportunity possible to heal over is about the only remedial measure that is practicable. Bridge grafting over the wounds, which is commonly employed with the apple and pear, will not yield satisfactory results in the case of the cherry.

Root Killing—The roots of fruit trees growing in dry sandy soils and in exposed situations are subject to more or less winter killing. This of course is more serious in northern latitudes and in areas or during seasons where snowfall is light. Cherry trees are not more subject to this form of injury than fruit trees of other kinds, but over a period of years the losses due to this cause are heavy. In the north, therefore, special care should be exercised to set cherry trees only on soils where deep rooting is possible. Soil management methods which build up the supply of organic matter and blanket it with a luxuriant growth of cover crops or of weeds, thereby avoiding such deep and severe freezing are effective preventive measures. As has already been stated in connection with the discussion of stocks, trees propagated on Mazzard roots are much more susceptible to root injury than those growing on Mahaleb.

Bud Killing—In some of the more northern sections the fruit buds of the cherry are subject to winter killing. This may occur at almost any time during the winter but is characteristically a late fall or early winter type of injury. This might lead to the inference that it is associated with immaturity and that preventive treatment lies in cultural treatments that encourage early and very

complete ripening of the wood. On the contrary the available evidence indicates that fruit buds on early ripened wood are distinctly more susceptible than those that presumably are differentiated somewhat later in the season and that consequently are not so far advanced when winter comes on. In other words the fruit buds of the cherry are less likely to be winterkilled because of immaturity than they are because of over development. Prevention, therefore, lies in promoting a vigorous moderately late growth whose buds will not be too far advanced; nevertheless it must not be so extremely late or vigorous that the wood fails to acquire maturity. In practice this means the use of such soil management and pruning practices as will lead to a maximum formation of fruit spurs and of spur-borne rather than shoot-borne fruit buds. Less attention needs to be given this matter in sections where bud killing is unimportant.

X

INSECTS AND DISEASES OF THE CHERRY

The cherry tree and its fruit are subject to the attacks of a number of insects and diseases and likewise to injuries caused by extremes of weather and other unfavorable environmental conditions. It is desirable for the grower to learn to recognize these troubles, to know how to avoid them so far as possible and to be ready to employ remedial measures should they once appear. Failure to deal effectively with them, even during a single season when there is a severe attack, may result in the entire loss of a crop or even of the trees themselves. This statement holds in a way for the other fruits, but it applies with particular force to the cherry. Other kinds apparently have greater recuperative ability after they have been severely injured. Furthermore, though spraying or other protective measures are often unnecessary with other fruits until the trees reach bearing age, they should be employed from the very start with the cherry. It is recognized that many cherry trees are grown to bearing age or even longer without spraying, but an attempt to do so on a commercial scale is attended by considerable risk.

The following descriptions and discussions are not intended to be complete or exhaustive. They include the more important disorders and are detailed enough to enable the reader to diagnose the cause or causes of the common troubles from their usual symptoms.

General and Localized Troubles

The troubles that affect fruit trees may be classed conveniently into two groups: (1) those that are general, seeming to attack or affect the entire tree more or less uniformly and (2) those that affect individual parts, causing local injuries to trunk, branch, leaf or fruit. No sharp line, however, can be drawn between these two groups of disorders. Thus a fungus attack that causes definite localized lesions on twigs or leaves, occurring in epidemic form, may superficially have all the appearance of a general or constitutional disorder. On the other hand the first symptoms that the grower recognizes of a localized bark and cambium injury to the crown may be a general slowing down of growth throughout the top of the tree. Careful examination, however, will usually make possible an accurate classification of the trouble as one of the general or constitutional types or as one of a distinctly local nature. It should be stated in this connection, however, that the term "local" as here used refers to the individual tree and its parts and not to the orchard. Thus a "general" disorder may be localized in the orchard, as on an exposed knoll or in a poorly drained pocket.

General or Constitutional Disorders Affecting Growth

Failure on the part of a cherry tree to make a satisfactory amount of new growth may be due to any one of several factors. Among the more important are: drouth, poor soil, injury to the root system, crown injury and blackheart.

Under ordinary conditions trees that are growing where

they suffer more or less frequently from drouth make a fairly normal growth during the early part of the season. Leaves are of usual size and color, though the shoots may be somewhat shorter than where there is a more abundant moisture supply. Toward midseason, however, distinct drouth symptoms begin to appear. The fruit fails to attain proper size and following harvest there is likely to be more or less premature defoliation. Loss of leaves from drouth is gradual—that is there is no sudden wave of first yellowing and then dropping leaves—and it is the more basal leaves on the shoots that drop first. There is a residual effect the following year, evidenced by a smaller amount of new growth, fewer blossoms and lower yields. When the tree shows symptoms that suggest drouth injury, the character of the soil itself and of the subsoil, determination of the approximate depth and spread of the roots and observation of the distribution of the injury in the orchard will usually serve to confirm or discredit the diagnosis.

The remedial measures that are at once suggested are irrigation to supply more moisture or methods of soil management that better conserve the moisture already available. These will include more thorough tillage, the use of cover crops to increase the humus supply, the use of windbreaks and perhaps in some cases artificial mulching.

The symptoms of starvation differ somewhat from those attending drouth. The leaves are somewhat smaller and a dull yellowish green instead of a bright dark green in color. The shoot growth is very short; indeed it is almost impossible to find real shoot growth in badly starved trees, the terminals being spur-like in character. Though trees suffering from lack of plant nutrients shed their

leaves somewhat earlier in the fall than those growing in a fertile soil, there is no premature defoliation along in July and August. Production of starved trees falls off to correspond with the amount of new growth. As in the case of trees where drouth injury is suspected, diagnosis can usually be confirmed or discredited by an examination of the soil itself and noting the localization of the symptoms in the orchard. Methods of dealing with the soil fertility question are discussed under Soil Management Methods.

The symptoms of cherry trees whose root systems have been partly destroyed by winter cold, by a temporary rise in the water table or by other causes are more or less intermediate between those of trees suffering from drouth and those suffering from starvation or perhaps more accurately they are a combination of both. Shoot growth is checked, as in cases of starvation; the leaves, however, are of nearly normal size and color. In addition the leaves of root-injured trees show a distinct tendency to fold inward along the midrib. Indeed this is so characteristic a symptom that wherever it is noted root injury may be suspected and an examination should be made to determine definitely whether or not this is the immediate cause of the trouble. Methods of preventing root injury are discussed in the chapters on Soil Management and on Winterinjury and need not be repeated here. Remedial measures are seldom satisfactory if a considerable part of the root system has been destroyed. If the injury has been light or light to moderate, the tree will gradually outgrow it. Fertilization, cover cropping and mulching to provide a more adequate nutrient and moisture supply, coupled with some pruning to reduce re-

quirements of the top, will help tide the tree through this critical period of readjustment.

The form of winterinjury known as blackheart leads to a checking of growth more or less similar to that caused by a deficient nutrient supply or by starvation. Little new shoot growth is produced each year. The leaves, however, are of approximately normal size, though in color they resemble those of trees suffering from a deficient nutrient supply. They show no tendency to curl or fold inward, like those of root-injured trees; but before falling in the autumn they often acquire a distinctive pale purplish caste. When blackheart symptoms are suspected the diagnosis can be made certain by cutting into some of the twigs and branches. Methods of prevention are discussed in the chapter on Winter Injury.

Localized Injuries Affecting the Roots

Root Killing—Root killing, as described and discussed in the chapter on Winter Injury may be classed either as a general or as a localized trouble. In the cherry the symptoms are likely to characterize the entire top rather than individual limbs, as is so frequently the case with apples. As these same symptoms are likewise more or less characteristic of blackheart and those attending drouth and starvation, only an examination of the roots will make possible definite diagnosis. Killing of the surface roots is more frequently due to winter cold; death of those penetrating the soil to the greatest depth is likely to be due to a temporary rise in the water table. Remedial measures have been presented in connection with the discussion of winterinjury. If root killing is due to a high water table, prevention lies in proper drainage.

Mushroom Root Rot—The term mushroom root rot is given to a fungus that often causes considerable trouble in orchards set on recently-cleared land. It is of only secondary importance in the middle west and east, but serious in the Pacific Coast states. The disease is due to a wood rotting organism that spreads from the decaying roots of forest trees to the live root tissues of recently planted nursery stock. It leads gradually to the death of the larger branch roots or of the main taproot, extending up to the crown. If detected in an early stage the affected tissues may be cut away, the resulting wounds treated with an antiseptic and the tree will recover. More frequently detection is too late to save the tree. The disease can be largely avoided by planting only on land that has been under cultivation for several years following clearing; or, if it seems desirable to set newly cleared land to trees, large holes should be dug and these then filled with soil free of decaying tree roots. The orchard trees are then set in this comparatively disease-free soil.

Localized Injuries Affecting Trunk, Branch and Shoot

Dieback—The most serious form of dieback, that to which the shot hole fungus and winterkilling are both contributing factors, has already been described and discussed under Winter Injury (See Fig. XIV). In some of the more northern states dieback of some of the topmost limbs is also likely to follow the defoliation caused by climbing cutworms or other leaf-eating caterpillars in spring. Starvation, drouth and overbearing are all contributing factors to dieback. It is almost invariably most serious in trees that are past their prime or that are failing to make a reasonably vigorous growth. Preven-

tion and likewise remedial measures consist in spraying to keep the foliage healthy and in such cultural treatments as tend to maintain the tree in a vigorous condition.

Borers—The cherry is distinctly less subject than some of the other fruits to borers in the crown and trunk but it is particularly susceptible to the attacks of a group of wood-boring beetles, sometimes known as "pin hole" borers, in the smaller limbs and twigs. The term "pin hole" is sufficiently descriptive of the work of these borers to make further description unnecessary. They seldom attack strong vigorously growing trees but may become very serious in those that are first weakened by winter-injury, shot hole fungus, drouth or other causes. Twigs and branches that are attacked in turn become very subject to dieback. There are no direct remedial measures that are very satisfactory. However, anything which tends to reinvigorate the tree helps it to recover from the injury caused by the borers and at the same time seems to serve as a repellent. Since borers of this type are usually harbored in dead or dying branches or brush in timberland, fence rows, orchard prunings, etc., the value of "clean up" measures about the orchard is obvious.

Scale Insects—Though ordinarily the cherry is less seriously affected by scale insects than most of the other fruits, control measures must sometimes be employed. It is seldom, however, that dormant season spraying is necessary in the cherry orchard more than once in five or six years and many commercial cherry orchards never require this treatment. The San Jose scale seems to avoid the cherry.

Gummosis—All of the stone fruits are subject to more or less gumming. Wherever the bark is injured, perhaps

mechanically, or incident to a growth crack or the pressure at a crotch, there is likely to be more or less gum formation. This is entirely natural and does not indicate a diseased condition. On the other hand, copious exudations of gum or the formation of extensive gum pockets underneath the bark or between its different layers, usually indicates the presence of a bacterial disease known as gummosis (Fig. XV), though sometimes they are only symptoms of general debility due perhaps to starvation or "wet feet" or perhaps to nutritional disturbance occasioned by heavy pruning. The bacterial form gains entrance through mechanical wounds or insect punctures and works in the cambium layer. It spreads rapidly, soon leading to the girdling of an entire limb or even of the trunk. In this respect it differs somewhat from the form occasioned by physiological disturbances. It is found on cherry trees of all kinds but is especially serious in the sweet varieties. It is much more severe on the Pacific Coast than in the middle west or east. Indeed it is probably the most serious disease attacking cherry trees west of the Cascade—Sierra Nevada range of mountains. It is distinctly less troublesome in semi-arid than in humid districts and trees that get to be 12 or 15 years old apparently acquire a certain degree of resistance to it. If susceptible varieties are top-budded into the limbs of Mazzard seedling stocks, the crown, trunk and crotches are likely to be comparatively resistant to the disease and control is simplified, but it is difficult if not impossible to secure nursery trees propagated in this way and few growers are willing to go to the trouble of propagating their own trees in this manner. Furthermore, satisfactory Mazzard seedlings are sometimes difficult to procure. The only satisfactory remedial measure for the bacterial

gummosis is to cut out the diseased tissues wherever infection occurs. Growers raising susceptible varieties and living in districts where gummosis is bad should carefully inspect their young trees several times each season and take prompt measures to cut out the disease in order to hold it in check. Care should be exercised to see that all traces of the disease are removed. Wounds made in cutting out gummosis lesions should not be treated with any sterilizing agent or paint, but should simply be left to dry out and eventually callus over.

Bark Excrescences—The outer fibers of the bark of cherry trees run around the trunk or limb rather than lengthwise. As they are comparatively tough the result is that both trunks and limbs become bark-bound. Finally, however, the pressure, due to the growth of the wood on the inside, becomes great enough to break the bark fibers. Such breaks are usually irregular and are followed by a rapid growth of woody and cortical tissues crowding out through the break. The result is that eventually the trunk of the tree comes to be comparatively irregular in outline, with more or less irregularly alternating areas of smooth bark where cracks have not occurred and rough areas that appear more or less like wart-like excrescences. This is an entirely normal condition and nothing to cause alarm. It can be prevented to some extent by cutting vertical slits through the outer layers of bark with the point of a knife every two or three years, thus giving the trunk a chance to expand more evenly. It may be doubted, however, if this practice is commercially practicable, though it may result in smoother trunked trees.

Localized Injuries Affecting the Leaves

Dwarfed Foliage—The leaves of trees in a badly

weakened condition because of poor soil, drouth, hardpan, root killing, winterinjury of the blackheart type, or a number of other causes are usually below normal in size and have a rather pale yellowish green instead of a rich dark green color. Field examination will usually indicate which of these factors is responsible for the trouble.

Yellow and Purple Foliage—Yellowing, followed by premature dropping of the leaves is so common in the cherry orchard that it may almost be said to be a characteristic of this fruit. Most yellowing is due to obvious causes but in some cases it is impossible to assign a definite reason for it. That which is due to drouth or starvation is likely to come comparatively late in the growing season and is seldom accompanied by any distinct spotting. The same statements apply to the yellowing which characterizes blackheart injury, except in that case the leaves are likely to develop a dull purplish caste shortly before they fall. Yellowing that follows an attack of the leaf spot disease or that is an evidence of spray injury generally comes much earlier in the season. The characteristic leaf spot lesions make possible identification of the cause of the trouble in that case. When the cause of the yellowing has been correctly determined it is usually easy enough to prescribe suitable preventive measures.

Leaf Spot or Shot Hole Fungus—These two terms are sufficiently descriptive to make possible identification of one of the most serious diseases of the cherry. The lesions first appear as minute dark colored spots, not as large as a pin head. As they increase in size they develop a purplish tinge, except at the center. Finally the entire spot (which becomes perhaps an eighth of an inch in diameter) turns brown and the dead tissues drop out,

giving the leaf a perforated or "shot-hole" appearance. Usually affected leaves promptly turn yellow and drop off (Fig. IV). As already indicated, trees defoliated prematurely as a result of leaf spot attack mature their wood poorly and are especially susceptible to winterinjury of the blackheart and dieback types. Even though they suffer no winterinjury their growth is seriously checked and production is reduced. If the leaf spot attack comes early in the season so that a large percentage of the foliage is lost before the picking season, the fruit does not attain normal size, never ripens properly and often is not saleable.

In general varieties of the sour group are less resistant to leaf spot than those of the sweet group. The Morello group is especially susceptible.

Though leaf spot is one of the most serious diseases of the cherry, directly responsible for many crop losses and indirectly responsible for the premature dying out of many trees, it is comparatively easy to control. From two to four thorough and timely applications of Bordeaux mixture, of lime-sulphur or of any one of several other fungicides, will hold it in check.

Mildew—The leaves of the cherry are occasionally attacked by a mildew. Such attacks, however, need not be expected in orchards given the regularly recommended spraying treatment for leaf spot.

Aphids (Plant Lice)—During unusually humid seasons the shoots of the cherry are often severely attacked by a species of aphid. The leaves are badly curled and dwarfed, shoot growth is checked and the honey dew secreted by the aphids more or less covers both foliage and fruit, only to furnish a medium for the growth of a sooty mold that makes the fruit practically unsaleable.

Sweet varieties are usually more susceptible than those of the sour group and young vigorously growing trees are more susceptible than those well into bearing and growing more slowly.

Control sometimes proves rather difficult, especially if the aphids are allowed to get much of a start. If, however, a careful watch is maintained and the trees are sprayed or dusted thoroughly with a suitable nicotine-containing material at their first appearance, the aphids can be held in check.

Slugs and Caterpillars—In common with many other fruits the cherry is subject to the attack of a number of leaf eating insects. Chief among these is the slug, a slimy caterpillar that eats off the soft tissues of the leaves leaving the ribs and veins. These caterpillars are easily controlled by spraying with arsenate of lead. Bearing trees that are receiving a regular spraying schedule for the curculio and maggot do not require any special treatment for slugs or caterpillars.

Climbing Cutworms—In some sections cherry trees are attacked by climbing cutworms. These are caterpillars that spend the day in the soil or hidden away under debris or in deep wound cavities. At night they emerge and, climbing out to the ends of the very topmost limbs, feed on the opening buds. They are voracious feeders and may soon strip a tree of its developing foliage and blossoms. The attacked limbs fail to leaf out and are very likely to die back. As the work is all done at night the caterpillars are not likely to be seen and their presence may not be suspected. They sometimes do an immense amount of damage within a short time. The most satisfactory method of control thus far devised is to put a narrow band of tree tanglefoot about the trunks or

main limbs of the trees each spring, thus preventing the caterpillars from climbing the trees.

Localized Injuries Affecting the Blossoms

Blossom Blight—The brown rot fungus sometimes attacks the blossoms of the cherry. The blossoms turn brown, appearing as if struck with a blight. Fruit setting is prevented and the crop correspondingly reduced. This disease is likely to be serious only during protracted periods of very warm, humid weather at blossoming. It is generally considered unnecessary to spray cherry trees before their blossoms open, but if experience shows that with the varieties and in the section in question, much blossom blight may be expected, the application of a preblossoming fungicide is to be recommended.

Localized Injuries Affecting the Fruit

Curculio—Most of the worms of wormy cherries are the larvae of a snout beetle—one of the curculios. Infested cherries are ruined. Control lies in two or three thorough applications of an arsenical poison between the time of fruit setting and of harvest.

Maggots—The cherry maggot is the larva of the so-called cherry fruit fly, an insect resembling somewhat the ordinary house fly but considerably smaller. These maggots tunnel through the fruit, making it unfit for human consumption. Infested fruit is sometimes difficult to detect as it presents an almost normal appearance. However, it is somewhat lower in specific gravity than uninfested fruit and a comparatively large proportion of such fruits will float in water. This test is sometimes employed in commercial canning factories. Satis-

factory control may be obtained by two or three applications of an arsenical poison between the time of fruit setting and harvest, the same treatment being effective for this pest as for the curculio.

Brown Rot—Both sweet and sour cherries are subject to the attack of the brown rot fungus shortly before maturity and also after they leave the tree. Rotted fruits are brown in color and in the later stages of decay may be covered by tufts of the rot-producing fungus. The sweet cherries and Duke varieties are especially susceptible and the disease is much more serious during seasons of high temperature and high humidity. Ordinarily the spraying applications which are used to control leaf spot render special treatment for brown rot unnecessary.

Fruit Cracking—Rain or irrigation, or even a period of high atmospheric humidity just before or during the harvesting season, especially if preceded by a period of rather dry weather, is likely to cause more or less cracking of the fruit. Sweet cherries and some of those of the Duke group are especially susceptible. The exposed fleshy tissues are very subject to decay by brown rot and other fungi. There is no remedial treatment and likewise no preventive treatment is very satisfactory. The best that can be done is through good soil management methods to keep the fruit developing steadily and not permit it to become checked in its growth.

Wind Bruises—Both sweet and sour cherries are subject to bruising by being blown against other fruits, spurs, limbs and twigs. The skin may not be broken but the flesh turns brown and presents the appearance of a local infection of the brown rot fungus. Though the quality is not seriously injured, appearance is and market

value is correspondingly lowered. Windbreaks to protect the trees and light pruning that leaves the tops of the trees comparatively dense are the only known means of preventing this trouble.

XI

SPRAYING THE CHERRY ORCHARD

THOUGH the cherry is subject to the attacks of a rather large number of insects and diseases, the spraying schedule that is necessary to hold them in check is comparatively simple. Seldom are more than four applications per season necessary and many growers manage to get along with three. The accompanying schedule or "calendar," though not exactly suited to all conditions, may be regarded as fairly typical of what will generally be required.

The first application mentioned in the schedule is the so-called "dormant season" spray. This is primarily for the control of scale insects. Scale insects, however, seldom cause much trouble in the cherry orchard and under average conditions a special spray for them is not required more than once or twice each decade. Indeed there are many cherry orchards that never require this application. Only when scale insects are found on the trees in considerable numbers is the grower warranted in making it. In spite of this, however, many producers make it a regular practice to give their cherry orchards a dormant season application along with their other fruit trees, though its cost is wasted. The fact that this application is seldom necessary gives the cherry producer a distinct advantage over the producer of most other tree fruits, because, as compared with the summer treatments, the materials used in this dormant spray are relatively

CHERRIES

APPLICATION	*MATERIALS*	*TO CONTROL*	*EXPLANATIONS*
1. DORMANT. Apply just before growth starts.	Lime-sulphur, 12½ gallons with water to make 100 gallons.	Scale insects.	Sour cherries are rarely affected by scale insects, and the sweet varieties only occasionally. Spray for scale only when it is known to be present.
2. PETAL-FALL. Just after the petals have fallen.	Lime-sulphur, 2½ gallons, lead arsenate, 2 lbs., and water to make 100 gallons.	Leaf-spot, brown-rot, curculio and slugs.	This application should be completed by the time the "shucks" are falling.
3. TWO-WEEKS. Should be completed within two weeks after petal-fall.	Lime-sulphur, 2½ gallons, lead arsenate, 2 lbs., and water to make 100 gallons.	Leaf-spot, brown-rot, curculio and slugs.	
4. FOUR-WEEKS. Should be completed within four weeks after petal-fall.	Lime-sulphur, 2½ gallons, lead arsenate, 2 lbs., and water to make 100 gallons.	Leaf-spot, brown-rot, curculio, slugs and maggots.	Lead arsenate should not be used later than this (before harvest) except on fruit that will go to the canning factory and will be thoroughly washed.
5. AFTER HARVEST. Just after the fruit is harvested.	Lime-sulphur, 2½ gallons, lead arsenate, 1 lb., and water to make 100 gallons.	Leaf-spot and slugs.	This is desirable to prevent the development of leaf-spot and slugs.

SWEET CHERRIES. All cherries should be sprayed according to this schedule, but for summer applications of sweet cherries the lime-sulphur should be used at the rate of 2 gallons in 100. Avoid heavy spraying.

SPECIAL. If leaf-spot has become established in the orchard it is desirable to use 3 gallons of lime-sulphur with water to make 100 gallons and to shorten the interval between applications. If shoot growth is not complete at the time of Application 4, spray again with lime-sulphur alone, or with lead arsenate if necessary for cherry maggots, in 10 days.

expensive and the work must often be done while the ground is soft and the spraying outfit can be hauled over it only with considerable difficulty. The idea entertained by many growers and sometimes encouraged by those having dormant season spraying materials to sell that this application is effective against the cherry aphis is not borne out by the results of many carefully conducted experiments.

In those districts and with those varieties where brown rot is especially prevalent and causes serious loss of blossoms through the infection of the flower pedicels, an application of a fungicide just before the flowers open is desirable. For the most part the necessity of this application is limited to some of the more humid districts of the Pacific Coast states.

The first of the three most important spray applications in the cherry orchard should be made immediately after petal fall. Preferably it should be completed by the time the "shucks" are falling from the swelling cherries. The second and third applications should follow at approximately two-week intervals. The main purpose of these three sprays is to control the four most serious pests of the cherry—leaf spot of the foliage and the brown rot, curculio and fruit fly which attack the fruit. Incidentally these same applications serve to hold in check a large number of the less serious pests. A combination of lime sulphur and lead arsenate is recommended for all three applications. If they are timely and thorough they are usually all that is necessary to carry the fruit through to maturity without much injury. On the other hand, if the fruit fly, or maggot, has been causing considerable trouble it may be desirable to make an additional application (using lead arsenate alone) about 10 days after the

three that have just been mentioned. Under some conditions these summer applications of lime-sulphur and arsenate of lead have resulted in injury to the pedicels or stems of the developing fruits, causing them to shrivel and drop prematurely, or, in milder cases, they have lead to more or less serious dwarfing of the fruit. Where this trouble becomes acute, it can be dealt with more or less effectively by substituting the dry-mix sulphur-lime mixture for the standard lime-sulphur preparation, especially in the later applications.

Immediately after harvest the trees should again be sprayed with the lime-sulphur and lead arsenate combination to protect the foliage during the summer and fall from leaf spot, slugs and caterpillars. If the spraying program before harvest has given practically perfect control of all these pests, this post-harvest application can perhaps be omitted without incurring any great risk, but in general it is to be recommended.

In those districts and with those varieties where brown rot is especially severe it may be desirable to make an extra application a week or ten days before the fruit is picked. Preferably this should be a dust application, either of sulphur with five to ten per cent of hydrated lime or some other "fluffer," or of monohydrated copper sulphate. The reason for a dust instead of a spray application at this time is to avoid staining the fruit.

Some seasons and in some sections the black cherry louse becomes a serious pest, curling and dwarfing the leaves on the developing shoots, checking the growth of the shoots themselves and, in severe cases, leading to a dropping of the fruit. Furthermore, some of the honey dew secreted by the aphids drops on the fruit and it is soon covered by a black sooty mold. The appearance

of the fruit is injured and it may be rendered unsaleable. The remedy lies in prompt and thorough spraying with nicotine sulphate when the aphids first appear. This is usually just as leaf growth is nicely starting and before blossoming. If application is delayed until the leaves are curled around the aphids, little will be accomplished. In making this application every leaf, twig and water sprout or sucker should be drenched.

The cherry is somewhat different from most other tree fruits in that approximately the same spraying schedule should be employed in the non-bearing as in the bearing orchard. Failure to spray young cherry trees has often resulted in their premature defoliation by leaf spot or slugs and a consequent check in growth and greater susceptibility to winter injury of the blackheart type. Indeed many cherry orchards never come into profitable production because of neglect of the spraying operation while the trees are young.

Spray Materials

The cherry producer is fortunate in that he does not need to have on hand a large number of different materials for spraying purposes. In most sections arsenate of lead, lime-sulphur and nicotine sulphate are all that he requires. In some districts it may be desirable to substitute Bordeaux mixture for lime-sulphur and in some instances a sulphur or a copper dust may be desirable. Bordeaux mixture, however, has been found to have a very distinct dwarfing effect on the cherry fruit and its use is not recommended except in sections where lime-sulphur applications result in considerable foliage injury.

Lead Arsenate—Lead arsenate is available in both powdered and paste form. The powdered form is some-

FIG. XII.—A MATURE MONTMORENCY CHERRY TREE AFTER A MEDIUM TO LIGHT PRUNING.

Note the prunings on the ground. Even this light pruning, however, when given each year, resulted in some reduction in yield.

FIG. XIII.—THE BRANCH AT THE RIGHT IS FROM A MONTMORENCY TREE WHOSE BLOSSOMS WERE OPEN TO INSECT (HONEY BEES) POLLINATION.

A number of colonies of bees had been placed in this orchard during blossoming. The one on the left is from an adjoining tree of the same variety enclosed in a screen wire cage during the blossoming season to keep out honey bees and other pollen-carrying insects.

what more convenient to handle and is preferred by most growers. For cherry spraying it is generally used at the rate of two pounds of the powder (or four pounds of the paste) to 100 gallons of spray. It is the safest of all the arsenicals for use in the cherry orchard.

Lime-sulphur—Liquid lime-sulphur is a concentrated liquid containing, besides water, a number of compounds of sulphur and lime. It serves either as a contact insecticide or as a fungicide, depending on its dilution. For use in a summer spray in the sour cherry orchard two and one-half gallons are diluted with water to make 100 gallons of spray; for application to sweet cherries two gallons of the concentrate are diluted to make 100 gallons of spray. When it is necessary to make a dormant season application to the cherry orchard in order to control scale insects 12½ gallons of concentrated lime-sulphur are diluted with water to make 100 gallons of spray.

Lime-sulphur is available in a dry as well as a liquid form. The dry form usually possesses, besides the ingredients found in liquid lime-sulphur some kind of "stabilizer." In general, however, the two products are similar. Both owe their insecticidal and fungicidal value to certain of their sulphur-bearing compounds. Whenever dry lime-sulphur is substituted for the liquid concentrate approximately four pounds should be used to take the place of each gallon of the liquid.

Nicotine Sulphate—The standard form in which nicotine is available for spraying purposes is a solution of nicotine sulphate which carries 40 per cent nicotine. This is diluted for orchard use at the rate of one pint to 100 gallons of spray.

Substitutes—Numerous substitutes are offered by the

trade for the standard spray materials that have just been mentioned. Some have proved satisfactory. Many others have proved unsatisfactory, either from the standpoint of giving control of the pest for which the application is made or because of injury to the tree or its fruit. Many crops have been ruined and the trees in many orchards seriously and permanently damaged because of unwise substitutions for the standard spray materials. Growers should refuse to deviate from standard practices and standard materials until the new methods or new materials have been thoroughly tested by the Experiment Stations and are recommended by them.

XII

HARVESTING AND MARKETING

Picking

There are no generally accepted standards as to the degree of maturity that should be reached before cherries are harvested. As with other fruits, there is a tendency to harvest some of the earlier varieties more or less prematurely in order to obtain the higher prices that are sometimes received for an especially early product. This holds true to a greater extent for some of the sweet varieties that are used to eat in the fresh state than for the sour varieties. There is no advantage in harvesting especially early that portion of the crop that is intended for the general fresh market or for the canneries, except perhaps to avoid the possible danger of cracking that may follow rains coming during the harvesting season. Color and flavor of fruit furnish the best guides as to when the crop really should be harvested. Fully colored fruit is always more attractive than that which fails to reach full maturity and the highest quality is obtained only when full maturity is reached on the tree. Both color and flavor of many fruits continue to develop after they have been picked; in a few cases they develop to better advantage after picking than if the fruit is left on the tree. Not so with the cherry. Ripening processes, at least in the sense of development of color and flavor, cease when the fruit is picked. It is therefore desirable

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from the standpoint of quality to delay harvesting as long as possible, though market demands and the necessity of spreading the harvesting season over as long a period as possible may make it desirable to adopt something of a compromise in this connection. The statement is ventured, however, that the total consumption of fresh sweet cherries is far less than it otherwise would be if growers were not so prone to harvest prematurely. Except in the case of sweet varieties that are subject to cracking, there is little or no loss from letting the fruit remain on the trees for a week or even two weeks after full maturity has been attained. This is often of great aid in permitting of an orderly harvesting and marketing of the crop and affords the cherry producer an advantage not enjoyed by producers of most other kinds of fruit. Furthermore, investigations show that cherries gain considerably in weight during their ripening period. This increase may amount to as much as 35 per cent in the case of sweet varieties between the time when conceivably they might first be picked (though premature) and full maturity. Cherries that are fully mature when picked remain firmer and are subject to less shrinkage in volume when canned than those that are picked comparatively early.

Cherries intended for shipment to distant markets or even for a fresh local trade are picked with their stems. Those intended for commercial canneries are generally "pulled" or "stripped," leaving the stems on the trees. No matter how carefully the stem is pulled out of any cherry, the tissues at the point of attachment are sure to be more or less injured and some juice exudes, resulting in the surface of the fruits becoming sticky and unattractive and furnishing a medium for the growth of

molds and other organisms. This is not a serious matter when the fruit goes to a commercial cannery and at most only a few hours intervene between time of picking and its being placed in the washing tanks of the cannery, but it practically ruins the product for the fresh trade.

Pails of convenient size, usually of six to eight quart capacity, are generally used as picking receptacles. When these are filled they are emptied into shallow lug boxes or crates for carrying to the packing shed or directly to the cannery in the case of the crop intended for that market. Sometimes the fruit is placed directly in the retail packages as it is picked from the tree but that makes careful grading practically impossible and is not to be recommended for either the sweet varieties or the Dukes. It may be warranted with varieties of the Montmorency and Morello types that are intended for local markets and where practically the entire crop is of a uniform high grade.

Pickers are generally employed on the pound or crate basis, the prices paid varying greatly with conditions. One to one and one-quarter cents per pound is an average figure for stripping. Half again to twice as much is paid for picking with stems. A good picker can strip from 300 to 400 pounds per day if the trees are heavily loaded and conditions are favorable. It is necessary to plan on an average of at least two pickers to the acre if the orchard consists of a single variety of full sized trees of such a variety as Montmorency that are loaded heavily; twice that number will be required for some of the sweet varieties whose harvesting season is shorter. If there is a succession of varieties the total force that will be required for a given acreage will be considerably smaller.

Grading

The grading of sour cherries is usually limited to the sorting out of all specimens showing evidence of the presence of curculio, fruit fly (maggot) or brown rot or that are cracked. Sometimes fruit showing any considerable amount of wind bruising (evidenced by a brown discoloration of the skin) is also culled out. All that passes this inspection is put in one grade. This does not mean that larger and better colored lots do not bring a premium; they do but they are not sold under a different grade label. Sweet cherries, on the other hand, are usually sorted into several grades according to size, after blemished specimens have been removed. In general the highest prices are obtained for the largest fruits.

Packages and Packing

As already stated, cherries are generally delivered to the canneries in lug boxes, holding 35 to 40 pounds. Fruit intended for strictly local markets is sold in a great variety of packages. There is a steady tendency, however, toward the use of the smaller packages—one quart baskets carried in 16 or 24-quart crates and special shallow boxes holding 1, 2, 4, 8 or 10 pounds. The former are used more for the sour varieties, the Dukes and the soft fleshed varieties of the sweet group; the boxes are used more for the firm fleshed sweet varieties of the Bigarreau type, such as Lambert, Bing, Schmidt and Black Republican. In the box-packed fruit each specimen of the face layer is placed on its flat side and the fruit is arranged in a neat straight or diagonal design. Sometimes every individual cherry in the entire box is placed just where it belongs in this same way. These fancy

packs present a very attractive appearance and find their way into many homes, as well as supplying the bulk of the fruit stand trade (Frontispiece). The so-called "jumble" pack is generally used in filling the other packages used for cherries, though sometimes the one-quart baskets are faced with a single layer. What pack is best depends both upon the kind of fruit that is grown and the demand of the market on which it is sold.

Storage and Shipping

Cherries are not well suited for long holding in storage, though sometimes they are held to advantage for a few days while the market is being cleared of an over supply. If they must be placed in storage it is desirable to hold them at a relatively low temperature (32°-40° F.) to lessen wilting and also loss from brown rot. Preferably they should be stored after grading and packing, as the packed fruit cools more quickly and is less subject to decay than when stored in larger containers.

If the fruit is to be sold on the local market no artificial cooling is required; but, if it is to be shipped any considerable distance, it is best to precool it and then ship in refrigerator cars. Most of the fresh cherries shipped from the Pacific Coast states to the middle west or east are shipped in refrigerator cars. Non-refrigerated express and parcel post shipments of well packed firm fleshed sweet cherries may be made to a distance of 1000 to 1200 miles. For similar shipments of soft fleshed sweet cherries of the Duke or sour varieties a quarter of that distance is likely to prove impracticable. However it is possible to transport well graded and well packed soft-fleshed cherries by truck distances of 100 to 125

miles over good roads. One Michigan grower has found it profitable to truck sweet cherries of the Bigarreau type 350 miles to Chicago, the better condition of the fruit upon its arrival and the saving in time and expense of cartage at destination more than compensating for the extra cost of such shipments over those made by refrigerator cars.

In another chapter mention was made of the recent development of the demand for frozen cherries by restaurants, bakeries, etc. Cherries intended for that trade are washed and then packed in barrels (with or without pitting) as soon as possible after picking. The barrels are then placed in a cold storage room held at a temperature of 12°-15° F., where they remain until wanted by the trade. At this temperature the fruit freezes up solid and can be held indefinitely. This method of handling is being extended to much smaller packages than the barrel.

Marketing

A comparatively large percentage of both the sweet and sour cherry crop reaches the consumer either directly or indirectly through the tin can, the frozen barrel or the glass jar. This means that the producer's market for a large portion of the crop is the cannery and that therefore his marketing problem is comparatively simple. He may not receive from the cannery a price that he considers entirely satisfactory, but the crop is usually contracted for at a definite figure long before harvesting begins and the problem of finding the ultimate consumer rests on the canner, not the producer.

When shipments must be made to distant points, the cherry grower is compelled to make use of the same

trade channels that are utilized by producers of fruits of other kinds. He may ship on consignment to a commission merchant or to a broker or carlot receiver or he may pool his crop with that of some of his neighbors and sell through a cooperative organization. Sometimes one, sometimes another, of these systems works out most satisfactorily.

Shipments that are trucked in to dealers in local markets (and local markets have come to mean markets within a distance of 100 to 150 miles) are usually sold on a cash basis. This trade is increasing rapidly, due partly to the increase in urban population and partly to the much greater use of the auto-truck as a means of transportation. There is almost invariably a keen demand for fresh cherries while they are in season and there is reason to believe that this outlet for the crop can be still further extended. The fact that restaurants find a marked increase in demand for cherry pie during the season of the year when fresh cherries are on the market (though, as a matter of fact, most of their pies are made from the canned product) is evidence on the popularity of this fruit.

The development of the tramp truck trade, where the producer sells to truckers who haul to more or less distant markets and there retail it as hucksters or sell to hucksters or other retailers, and the coincident development of farmer's roadside markets, have furnished the cherry grower important new outlets for his fruit. His product comes at a time when the trucker and the roadside market are not well supplied with other fruits. Furthermore, experience shows that well grown high quality cherries are able to compete successfully with other products for this trade. Many growers, who formerly experienced more

or less difficulty in profitably disposing of their cherry crop, especially some of their odd varieties, are finding a very ready sale for it through these channels. It is probable that this phase of the cherry business can be greatly expanded without oversupplying the demand. Indeed here is one of the most promising avenues for the expansion of the cherry industry. In order successfully to cater to this trade it is necessary to grow a considerable number of varieties, beginning the season with an extra early variety like Early Purple or Burbank and closing it with Late Duke or some other equally late and equally good variety. Needless to say much of the success that will attend catering to roadside market trade will depend upon high quality products and in packaging them attractively. The "truckers" demand will be more for quantities and packages suitable for the home canning trade, but nevertheless for fruit of good grade.

This chapter on marketing would not be complete without a statement regarding undeveloped possibilities for the marketing of the canned or preserved product. Taking it by and large, cherries are consumed mainly in those parts of the country where they are grown. There are important sections of the country where cherries are not grown commercially and where likewise they are not consumed in considerable quantities. Apparently this isn't because the people don't like them but rather because they haven't acquired the cherry eating habit. There is reason to believe that these areas constitute an important potential market for cherries. This market cannot, of course, be developed by the individual producer, but it is a legitimate field for the industry and its marketing organizations.

XIII

VARIETIES

As is true with most fruits that have long been in cultivation, the cherry variety list is extensive. Pliny mentions 10 varieties as being grown in Italy in his time. The latest monograph, that of Hedrick, describes 1,145 as having been grown at one time or another in America. Though this number is much smaller than that for apples or pears it is large enough to appear formidable to one unacquainted with the situation and contemplating the raising of this crop. In reality, however, the variety problem is much simpler in the case of the cherry than it is with most other fruits, even with fruits with shorter variety lists. This is because experience has demonstrated that a comparatively few varieties in each group stand out distinctly above the rest, at least when grown in certain broad areas or for certain specific purposes. Only a few of these more prominent and promising kinds will be described and discussed in this chapter.

The Sweet Varieties

The many varieties of the sweet cherry group have been classified or grouped in various ways. The term "Hearts" has been applied to those having a comparatively soft flesh, as contrasted with those having a firm flesh, which are known as "Bigarreaus." A large percentage of these soft fleshed cherries are more or less heart-shaped and it is from this characteristic that the group gets its name,

though the fruit of some of the varieties is globose or even oblate. The fruits of most of the Bigarreau group are more or less roundish in shape, though that of some varieties is as typically cordate as is that of any of the Heart group. Furthermore, texture of flesh does not always serve to classify the variety, for there are a number possessing a semi-firm texture that could be as logically assigned to the one as to the other group.

Comparatively few varieties of the Heart group have become important commercially, because of their poor keeping and shipping quality. Some of them, however, are unexcelled for home use and for strictly local markets.

Early Purple—The Early Purple, or Early Purple Guigne as it is sometimes called, is a variety of the Heart group that was introduced into America over a century ago. The tree is a good grower, a little earlier than many of the others to come into bloom, moderate in productivity. As the name indicates, it matures its fruit early in the season; indeed it is the earliest of what may be considered standard varieties. The fruit is of medium size and almost black if allowed to remain on the tree until fully ripe. It then possesses high quality, but it is often picked when only medium to dark red in order to be placed on the market early. The flesh is very tender and the fruit will not stand up well in storage, nor is it suited for shipping. On the other hand many growers have found it very profitable when grown in limited quantities for strictly local markets and for a roadside stand trade. It has been often recommended for the home orchard, but the fact that birds seem to prefer this to almost any other variety makes it doubtful whether it is desirable to grow it unless a number of

trees are planted so as to reduce the relative amount of injury from this source.

Knight—The Knight, or Knight's Early Black, is mentioned largely because of the fact that it is found in many of the older plantings. It is a variety of English origin that was once very popular in England and the eastern part of the United States. Though the tree is productive and the fruit is of high quality, it is below medium in size and therefore not well suited to market requirements. If it has any place in new commercial plantings, it is only in limited numbers as a second-early sort for the home markets.

Black Tartarian—Black Tartarian is one of the oldest, best known and most popular of sweet cherry varieties of the Heart type. The tree is enormously productive of medium sized fruits of excellent quality. Its season of maturity is comparatively early. Its flesh, however, is soft and the variety is therefore not one to be grown for shipping or commercial canning purposes. It is valuable for local markets and is probably the best early variety for the home orchard.

Burbank—This variety was originated in California by Luther Burbank. In that state, where it has been given extensive trial, it has come to be regarded as one of the outstanding early varieties, though not well suited for shipping purposes. It has not been thoroughly tested in the East.

Chapman—Chapman is another variety of California origin. It is supposed to be a seedling of Black Tartarian. It is somewhat earlier than that variety and surpasses it in size. It is the leading early variety in California, but is practically unknown in the east.

Windsor—Windsor is a firm-fleshed, large sized, black

cherry of the Bigarreau type that originated in Ontario. It is of high quality and the tree is very productive. Thus far its cultivation has been limited largely to New York, Ontario and Michigan, but in those districts it has proved one of the most profitable varieties. It is equally well suited for home use, local markets and shipment to distant points.

Bing—Bing, a variety of Oregon origin, has come to be regarded as one of the best varieties of the Bigarreau group. It seems equally well adapted to the cherry producing regions of California, the northwest and the northeast. It is one of the best shipping varieties. Its fruit is large, very firm and of excellent quality. It would be classed as a mid-season sort. The tree is productive.

Black Republican—Black Republican, or Republican as it is sometimes called, originated in Oregon and its culture is still limited largely to the northwest, though it is grown there in considerable quantity. It is a variety of the Bigarreau type. The fruit is seldom above medium in size but the flesh is exceedingly firm and of good quality. It matures a little past midseason. Though the tree is very productive, it is doubtful if extensive plantings are warranted on account of the frequent failure of the fruit to attain satisfactory size.

Schmidt—Schmidt, or Schmidt's Bigarreau, was introduced into this country from Germany. The tree is vigorous and productive. Its fruit matures in midseason, is of very large size, firm and of excellent quality. It is proving one of the most profitable of the sweet varieties in the northeast, but apparently it has not been given a thorough trial on the Pacific Coast.

Lambert—Lambert is another black cherry of the Bigarreau type of Oregon origin. It is grown in all of

the sweet cherry producing districts but has found greatest favor in the northwest. The tree is vigorous and productive. The fruit is large, firm and of excellent quality. Its maturing season is comparatively late. This is a distinct advantage in some districts. In others it results in the product coming into competition with mid season sorts from more northern districts. In some of the sections of the northeast its late maturity has made its fruit especially susceptible to cracking and its further planting is not warranted in those districts on that account.

Napoleon—The outstanding light-fleshed sweet cherry is the Napoleon,—also known as Napoleon Bigarreau and Royal Ann. Indeed it is the *one* white fleshed sweet cherry of real commercial importance in the United States. It is of unknown origin, coming to this country from Europe. The tree is vigorous and very productive. The fruit is large, firm fleshed and of excellent quality. Though classed as a white cherry, most of the fruits are blushed with a light red and almost the entire surface of those directly exposed to the sun may take on a brilliant red color. Though the flesh is nearly as firm as that of Bing, Windsor and a number of other varieties used for distant shipment in a fresh state, few such shipments are made of Napoleon. This is partly because its light colored flesh shows bruises readily and partly because the fresh demand is for dark colored cherries. Napoleon, however, is in great demand for canning and maraschino purposes. Indeed little fruit of other sweet varieties is used for either canning or the maraschino product. Since these industries are limited largely to the Pacific Coast states, few Napoleon cherries are produced in the northeast.

The Duke Varieties

There are fewer varieties of Duke cherries than of the other two groups. Only three will be discussed here.

May Duke—May Duke is one of the oldest of present day cherry varieties and the best known and most widely distributed of the Duke group. The tree is rather upright in habit and very productive. It matures its fruit comparatively early though not evenly. Two or three pickings are desirable. The fruit is medium to below in size, soft, tender and juicy in texture, but sprightly in flavor and of excellent quality. It is valuable for the home orchard and there is often a limited demand in home markets. It is not a variety, however, to grow in large quantities, because it is not suitable either for shipment or commercial canning.

Royal Duke—The Royal Duke resembles May Duke in both tree and fruit characters. The fruit, however, is somewhat larger and matures a little later in the season. The variety has a place in the home orchard and considerable quantities often can be disposed of to advantage in the home markets.

Late Duke—Late Duke is grown very sparingly, though its fruit is of excellent quality. The tree is a rather open, semi-upright grower, and moderately productive. The fruit is sprightly, sub-acid, tender and juicy. The maturing season is late to very late. It has a place in the home orchard and local markets will absorb limited quantities.

The Sour Varieties

Of the many varieties of sour cherries only three will receive mention in this discussion, since those three will

FIG. XIV.—AN EARLY RICHMOND TREE THAT IS SHOWING ADVANCED STAGES OF BLACKHEART INJURY.

Previous to the spring when this photograph was taken it had lost a number of its large limbs. Careful examination will reveal the fact that there has been further dying back of limbs, for the buds are not starting on some of the branches on the right hand side of the picture.

FIG. XV.—GUMMOSIS LESIONS ON A SMALL SWEET CHERRY BRANCH.

answer most of the purposes in this country which sour cherries are supposed to serve.

Early Richmond—Early Richmond is one of the oldest and most widely distributed of the sour cherries. In England and in some parts of the United States it is known as the Kentish. The tree is of medium size for a sour cherry and comparatively hardy. However, it is only medium to below in productivity, and for that reason is much less extensively grown than Montmorency. The fruit is slightly below medium in size and only mediocre in quality. It is valuable principally because it is one of the first of the sour varieties to mature and can therefore be used to lengthen the cherry harvesting season. Its extensive planting is not warranted, though it has a place in both the commercial canning and the fresh trade industry.

Montmorency—Montmorency is the leading sour cherry. A large percentage of the sour cherries raised in the United States reach the market through the commercial cannery and probably 90 per cent of the commercially canned product is of this variety. The tree is hardy, vigorous and very productive. The fruit is of good size and excellent quality. It matures in midseason or a little later and can be harvested over a considerable period. A number of strains of this variety are being propagated but the results of careful comparative tests are not available and one cannot be recommended over the other.

English Morello—Many dark fleshed or black sour cherries of the Morello type have been named and introduced to the trade. Few, if any, surpass the old English Morello. The trees are comparatively small, round-topped and spreading, often becoming drooping. Though vigorous at first, they come into bearing young, are ex-

tremely productive and are likely to be dwarfed by overbearing unless given the best of care to promote a reasonably vigorous growth. The fruit is medium to below in size, dark red to almost black, tart and of good quality. It matures late and will hang on the tree a long while after maturity without deteriorating. There is a limited demand for Morello cherries on local markets and a very limited demand for commercial canning. The foliage of this variety is especially susceptible to the leaf spot or shot hole disease and especially thorough spraying must be done to protect it.

XIV

CHERRY GROWING AS A BUSINESS

THE cherry orchard is planted, developed and maintained for the sake of the income that it will yield. If it is to be successful it must provide the owner with a wage for the labor that is expended on it and a reasonable interest on the investment—in brief with a living and a profit. The amount of this profit will depend on three main factors or groups of factors: (1) production costs, (2) yields and (3) prices.

PRODUCTION COSTS

Comparatively few data are available on what it costs to produce cherries. Few farmers keep detailed cost records and those that do seldom have them in such condition that it is possible to allocate to each field or crop or kind of fruit its share of the total farm expense. The data that are available probably do not represent average conditions but they will serve to give some idea of the size (both relative and absolute) of the more important factors that enter into production costs.

The Original Investment—The amount of investment that the cherry orchard represents at any stated age of course varies with conditions. It depends on the value or cost of the land, on the price paid for the nursery stock and what it costs to plant it, on both the labor and materials expended each year for cultivation, pruning,

spraying and fertilizers, on the profit from any intercrops and on the value of the first few crops of fruit that are harvested before the orchard becomes self supporting. Let us arbitrarily assume that the cherry orchard reaches the self supporting stage at about nine years of age and calculate what it is likely to represent in the way of an investment at the end of a nine-year period.

If the land is valued at $100 per acre and is utilized for a nine-year period for the growing of the trees, if an interest rate of six per cent is assumed and the interest is compounded annually, the $100 investment in land when the orchard was started has become a $200 investment by the time the trees are in bearing. If it is valued at $250 per acre to start with, it will represent a $500 investment per acre at bearing age. The desirability of starting with moderate priced land, assuming, of course, that it is well located and suited to cherry production, is apparent.

Cost of nursery stock together with cost of setting is likely to average $0.50 per tree. With sour cherries planted 20x20 feet this means an investment of approximately $50 per acre to start with, which, compounded as before, will amount to $100 at nine years of age. Cultivation costs annually are likely to average $7.50 per acre. There will be some replanting, some pruning, more or less spraying, probably some fertilizer applications and other incidentals. It is doubtful if $10.00 per acre per year would be too high an estimate for these items taken together. General upkeep and repair about the farm, a proportionate share of which must be charged against the orchard, will probably add another $10.00 per acre. When these items are totaled for the nine-year period and interest charges are computed on them they

amount to about $225. Add to these items an annual charge of about $2.50 per acre for taxes and insurance and a supervision charge of $5.00 per acre and another $75 has accumulated by the end of the nine-year period.

In brief, where the land is valued at $100 per acre, where planting costs are not extreme, where good care is given and interest as well as supervision and other necessary overhead charges are all computed, the orchard at nine years of age represents an expenditure of probably not less than $600 per acre. Subtract from this an estimated gross return of $100 from the sale of fruit during this early period and we have a net investment of $500 per acre. This at first may seem high, but it is probable that more orchards represent an investment cost above rather than below this figure. In one Michigan orchard for which detailed records were kept and in which the land was figured at $100 per acre, investment costs at nine years of age amounted to from $551.57 in one block of Montmorency trees to $854.28 in one block of mixed sweet cherries. Computation made from data obtained in 1927 by the United States Tariff Commission indicate that the average valuation for 33 bearing Napoleon Bigarreau cherry orchards located in the states of California, Oregon and Washington was $710.00 per acre.—

It will thus be seen that interest on land and trees alone will constitute a $30 to $50 per acre charge in the annual production cost of cherries.

Other Overhead Costs—Other overhead costs include supervision, insurance on buildings and taxes, general upkeep of the establishment (fencing, repairs to buildings, roads, tools, etc.) and a depreciation charge for the trees. All of these items vary greatly from place to place and with different conditions. However, it may

be assumed that adequate supervision can seldom be obtained for less than $5.00 per acre. If the grower personally supervises the operations in his own orchard, he does not have to pay out this amount, but his work of supervision will require time and he is entitled to compensation for it. Taxes on sour cherry orchards in some of the eastern states have been known to vary from less than $0.30 to over $6.00 per acre. Probably $2.50 per acre would be a fair average estimate for taxes and insurance together. Maintenance and upkeep of the establishment, including replacements and repairs to buildings and tools, is likely to be a fairly large item. A few records that are available suggest that $10.00 per acre per year would probably be a conservative estimate. The amount to allow for tree depreciation will of course depend on many factors. It will be relatively much lower in a well-cared-for long-lived orchard than in one that is neglected and that must come out at a comparatively early age. Assuming that the mature orchard on land that is valued at $100 per acre represents an investment of $500 at nine years of age, and that the trees are good for 20 bearing years, the annual tree depreciation charge will amount to $20.00 per acre. Sweet cherry orchards are likely to last longer than this, but at bearing age they are likewise likely to represent a larger investment, so it may be doubted if their annual tree depreciation is much less.

Together these estimated miscellaneous orchard costs, not including interest, amount to $37.50 per acre annually. With what may be assumed as an average interest charge, the total overhead costs are seen to amount to approximately $75.00 per acre annually. It should be pointed out in this connection that these

overhead costs go on indefinitely year after year, crop or no crop, and more or less regardless of whether the orchard is well cared for or more or less neglected.

Fluctuating Maintenance Costs—Though the amounts spent for cultivation, fertilizers, pruning, spraying and other incidental care will vary much more from year to year than the more or less established, permanent overhead costs, they always constitute a sizeable item. Indeed it is these fluctuating costs that the producer generally thinks of, often to the exclusion of the others, when production costs are mentioned, for they are the things that require a cash outlay each year. It is doubtful if a single application of spray material can be made to even medium sized sour cherry trees for less than $5.00 per acre and a full schedule for large trees may run as high as $30.00 per acre. Probably $15.00 per acre per year would be a fair estimate for average spraying costs, both labor and materials being included in this estimate. Some orchards are fertilized, others are not; some that are fertilized are given applications only once in a several year period. Probably $5.00 per acre per year would be a reasonable charge to assume as being adequate to maintain soil fertility in the average orchard. Cultivation, pruning, removing dead or diseased trees and propping, wiring and bracing, putting in a cover crop, etc. together are likely to constitute a $15.00 to $25.00 charge. An average figure of $20.00 per acre annually would be a conservative estimate to cover these items. The sum of these assumed average fluctuating costs is $40.00.

When all of these items are totaled it will be seen that it costs from perhaps a minimum of $80.00 or $90.00 to a maximum of $150.00 or $175.00 per acre to mature a crop of cherries. These figures represent their "on the

tree" cost. Harvesting costs are extra. Probably the average for most orchards lies somewhere between $100.00 and $125.00 per acre. When it is realized that these production costs go on, regardless of whether there is or is not a crop, it is obvious that costs per pound vary greatly depending largely on yield.

Harvesting Costs—Unlike the general overhead and the fluctuating annual maintenance costs, harvesting costs vary more or less directly with yield. During years of crop failure they are entirely eliminated. Pickers are usually paid by the pound rather than by the hour or day. Picking costs for either sour or sweet cherries that are "stripped" for the commercial canneries are likely to range from one to two cents per pound, with an average of perhaps one and one-fourth cents. Picking cherries with their stems is somewhat more laborious and costs a little more, perhaps averaging one and one-half cents per pound. To these figures must be added another quarter to half cent to cover the hauling and other incidental harvesting costs. Furthermore the extra handling and packing (including cost of package) required by sweet cherries and sometimes by sour cherries and Dukes that are intended for local markets will cost three to four cents additional per pound.

Yields

Yield data that will afford a fair idea of what to expect cherry trees to produce are difficult to obtain. If the United States Census showing numbers of bearing trees and total yields for the three Pacific Coast States for 1910 and 1920 are averaged it will be seen that the average annual tree yield is approximately 0.8 bushels or

about 40 pounds. Presumably most of these trees were of sweet varieties. Assuming now an average planting distance of 28x28 feet, allowing 55 trees to the acre, the average yield per acre would be 2,200 pounds. These figures, of course, include comparatively young bearing trees as well as those in full bearing and likewise those in poorly-cared-for as well as the better orchards. That they are not entirely out of line with conditions that actually obtain, however, is indicated by the fact that figures for 33 sweet cherry orchards having a combined area of 411½ acres in Oregon, Washington and California for the five-year period, 1922-1926, presented before the United States Tariff Commission in 1927, indicate an average yearly production of 2,522 pounds per acre. Similar data for 1909 and 1919 (Censuses of 1910 and 1920) for the remaining states indicate an average annual production per tree of approximately 0.25 bushels, or 12 pounds. Most of these trees are of the sour varieties, many of them are comparatively young and many are in non-commercial or poorly-cared-for plantations. Assuming an average planting distance of 20x20 feet, permitting 100 trees to the acre, this would mean an average annual production of 1,200 pounds per acre.

Most commercial cherry growers would at once say that these figures are too low, that they do not represent what good growers with well located orchards that are given suitable care can expect to obtain. Such is probably the case. Nevertheless the fact that they are averages means that, if many growers obtain much higher yields, there is an equal or still greater number that actually obtain lower yields. The 1920-1928 yield record for one Michigan orchard of Montmorency trees set in

1912 and standing 18x18 feet apart (135 to the acre) is given in Table 7. It will be noted that though frost injury was recorded in five out of the nine years, the average yield was nearly three tons to the acre—five times the figure given for the average sour cherry planting in the United States census reports. Another northern Michigan Montmorency orchard averaged 9,861 pounds

TABLE 7. Yield record (1920-1928) of a Montmorency cherry orchard in a rather unfavorable location in northern Michigan. Trees set 18 x 18 feet (135 to the acre), in 1912. Yields in pounds, reduced to an acre basis.

YEAR	*Age of tree*	*Yield in pounds*
1920	8	6,861
1921	9	2,700 *
1922	10	4,934 *
1923	11	9,257
1924	12	4,635 *
1925	13	11,008
1926	14	1,952
1927	15	906 *
1928	16	11,223
Average		5,942

* Some frost injury.

per acre per year during the some period and there is one authentic Montmorency yield record of 22,000 pounds per acre. These figures afford some idea of what an orchard of that variety can do where conditions are reasonably favorable and when it is well-cared-for. Incidentally the figures in Table 7 serve to illustrate the important part played by site in determining yield.

Ordinarily the English Morello, though productive as a tree, yields somewhat less per acre than Montmorency. Table 8 presents the 1924-1928 record of a block of mature trees of that variety. They were set 16½x16½ feet apart (making 160 to the acre). There were 200 trees

TABLE 8. The production record of 187 mature English Morello trees (200 in the original planting) set 16½ x 16½ feet apart. One and one-fourth acres in the plot.

YEAR	*Yield 16 qt. Crates*	*Selling Price Per Crate*	*Selling Price Total*	*Harvesting and packing costs Per Crate*	*Harvesting and packing costs Total*
1924	507	$2.35	$1191.45	$0.68	$344.76
1925	509	2.40	1221.60	0.68	346.12
1926	543	2.40	1304.73	0.68	369.24
1927*	...	...	.....	...	.....
1928	16,319 lbs.	0.07 (per lb.)	1142.33	0.01¼ (per lb.)	203.99
	5 16-qt. crates	2.55	12.75	0.68	3.40

* Crop failure due to frost

in the original planting but 13 had died out, leaving 187 for which this record is given. This particular record is comparable to that of the Montmorency orchards that have just been given and is far above the average. Indeed it is the record of one of the best blocks of Morello trees to be found anywhere in Michigan. Nevertheless it affords some idea of what can be done with this variety when the location is reasonably favorable and good cultural methods are employed.

Table 9 presents the 1919-1928 yield records of a block consisting of 657 sweet cherry trees set in 1913 near The Dalles, Oregon. They were set 30 feet apart on the hexagonal plan, making approximately 56 to the acre. The orchard was well located, on good land and ample provision had been made for cross pollination. Only once during the decade for which the yield records are available was there serious injury from frost. In brief the orchard is one that indicates production possibilities where conditions are almost ideal.—Incidentally the yield records of this sweet cherry block, those of the Morello orchard given in Table 8 and those that have been given

TABLE 9. Yield records of 11.7 acres of sweet cherries set 30 feet apart on the hexagonal plan in 1913 and located near The Dalles, Oregon. (50 Bing and Lambert, 453 Napoleon (Royal Anne), 144 Black Republican, 10 seedlings.)

YEAR	*Production in tons*
1919	3
1920	5
1921	8
1922	16
1923	36
1924	44
1925	55
1926	45
1927	23 *
1928	84

* Damage from late spring frost.

of several Montmorency blocks, serve to illustrate the permanent handicap of those fruit growers who, because of poor location, poor soil or poor management are unable to obtain more than average yields.

It is almost needless to say that when most of the production costs calculated on an acre basis are fixed (i. e., they go on whether or not there is a crop) production costs per pound vary inversely with the yield. If the maximum cost per acre ($125) given in a preceding paragraph is assumed, the average cost of Montmorency cherries as the mature fruit hangs on the trees ready for harvest in the orchard whose nine-year record is given in Table 7 was approximately $0.021 per pound. In 1927, when there was almost a crop failure, it was $0.138 and in 1928 when there was a good crop it was but a trifle over a cent per pound. A fair estimated average cost of the average 1200 pound per acre crop would be between eight and ten cents per pound.

Prices

Prices received for cherries fluctuate with supply and demand, just like those for other farm products. The prices paid for Early Richmond and Montmorency by one large eastern cannery during the 1916 to 1928 period ranged from four to 11 cents per pound, with an average of approximately seven cents. Perhaps six cents would be nearer the average that can be expected over another period of equal length, because three high-price "war years" are included in the above average. During the same period the prices received by western growers for sweet cherries averaged about eight cents per pound. Much higher prices are often obtained for an especially early or an especially fancy product that is sold in small packages, but the extra handling charges usually absorb a large part of the difference and the figures given come nearer to what growers actually receive for the product at the packing house or delivered to the cannery.

Profits

As stated in the opening paragraph of this chapter, the cherry orchard is developed and maintained for the income and profits that it will yield. To be really profitable it must yield an income above all labor and material costs and interest charges. With an average selling price of seven cents per pound and asuming an average production cost of $100 to $125 per acre, the cherry orchard that yields only the average 1,200 pounds per acre crop is a losing venture. Indeed it is only when yields exceed 2,000 to 2,500 pounds per acre that a profit above production costs (including interest charges) is possible. Perhaps in reality the amount is somewhat below that

figure, for in some orchards less than $100 per acre may be required to grow the crop to maturity. On the other hand there is little doubt but that the costs of others exceed $125 per acre. It will be seen that the better growers are able to make a substantial profit over all production costs. Indeed it may be questioned if the producer of any other kind of fruit has it within his ability to obtain greater net profit than the cherry grower. This is far from stating that profits are certain. Probably as large a percentage of cherry growers fail to make expenses as is true with most other fruits. Nevertheless the possibility of a profitable industry exists where soil and climate conditions are favorable for heavy and regular yields and where good marketing facilities are available; and this possibility becomes practically a certainty where cultural methods are employed that promote a vigorous growth and provide protection from injurious insects and diseases.

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